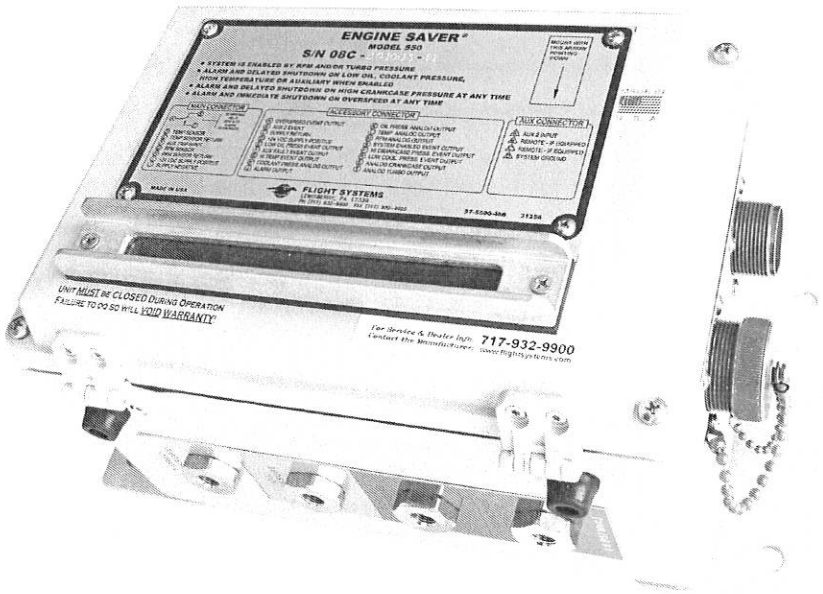
ENGINE SAVER®
MODEL 550
MANUAL



LEVEL 8

Applicable to Unit Serial No.
08 - 200806 - 01 *and up*

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207 Hempt Road Mechanicsburg, PA 17050 USA
Phone: 717-590-7330 Fax: 717-590-7327
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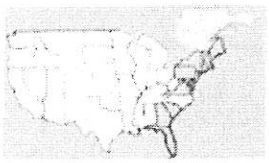

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Engine Saver® - Model 550

Providing Protection for Thousands of Engines Worldwide Since 1980

This is Engine Protection that works! Thousands in service worldwide, fully supported with on-site installation, spare parts and test equipment.

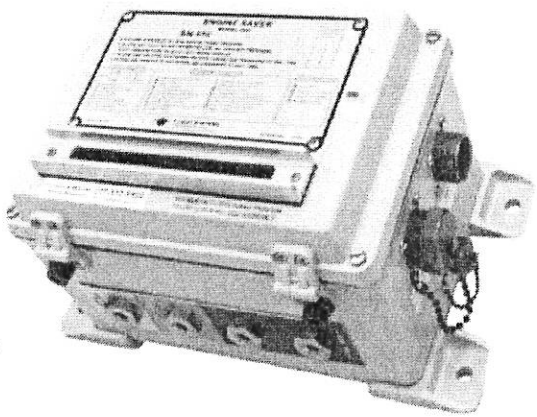
The Engine Saver® monitors a combination of pressure, temperature and RPM on 8, 12 and 16 cylinder diesel or gas engines, and detects the early signs of trouble before damage occurs - long before an attentive operator could detect it on the gauges - and without false alarms. Most common faults go undetected until they cause consequential damage or engine destruction

See What the Engine Saver has Done: Finsch Mine – Komatsu 680 Dump Truck powered by Cummins KT 1710 engine. The Engine Saver shut down on low oil pressure. Found blocked oil filter and diesel fuel in engine oil. Read more...

$300 Allowance for your old protection system when you Upgrade to the Engine Saver®! Click here for details

The Engine Saver® Detects:

- Loss of coolant
- Low coolant
- De-aeration baffle fatigue
- Broken/worn rings
- Hole in a piston
- Loss of oil
- Partially blocked oil or water pumps
- Fuel dilution
- Overspeed
- Overheating
- Clogged breathers
- Worn pump impellers
- Worn bearings
- Governor failure
- Radiator cap loose
- Scored cylinder



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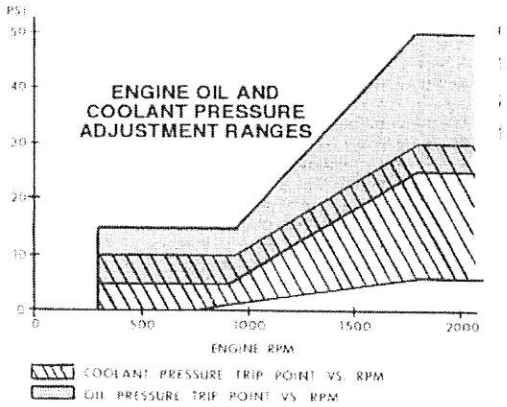
The engine is protected over its entire operating range from idle to peak torque to maximum allowable RPM.

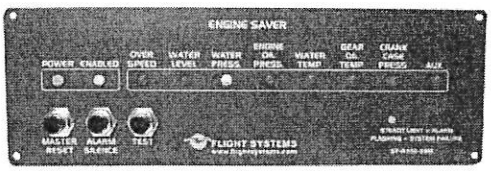
The unit is fully adjustable to suit all types of engines in all types of operating conditions:

- Mining
- Construction
- Irrigation
- Marine
- Railway
- Military
- Power Generation



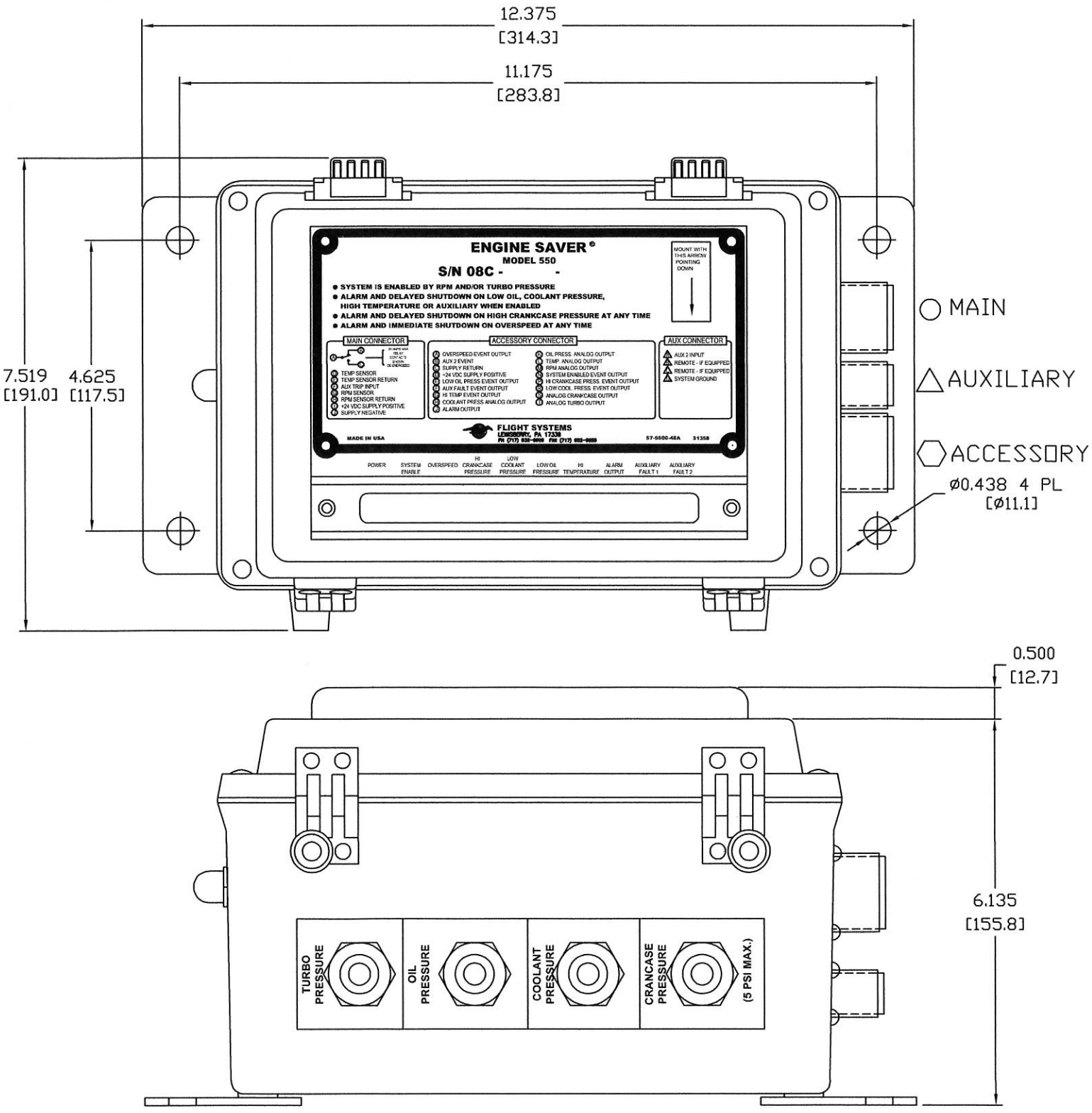
Features:

- Built-in status panel (Optional remote available) gives complete engine operating condition and fault location, even after shutdown.
- Auxiliary analog outputs for trend analysis and overhaul/maintenance forecasting via radio data link and/or on-board recording.
- SPDT heavy-duty output relay permits a wide choice of alarm/shutdown options including pre-shutdown warning.
- Trip points automatically lower when engine is idling or lugged down. All trip and enable points are fully adjustable. Enable time delay changes automatically with engine temperature.
- Unit will enable on Turbo Boost or RPM (or both) at installer's option. Choice of 3 RPM sources.
- All internal adjustments have status indicator and are marked for accurate and easy adjustment.
- Two custom optional inputs.
- Failsafe operation with flashing lights showing location
- Easy to install - complete manual supplied.
- Weather resistant and tamper proof; unit is lockable.
- 24V input - transient and reverse polarity protected, suppressors built-in to withstand nearby arc welding.
- Fully supported with spare parts, repair service and test equipment.
- LED Light Bar Remote Display Option shown below (57-A550-59M or I)



Parameter	Adjustment Range	Factory Setting
TURBO ENABLE	NON-ADJUSTABLE	8 PSI
RPM ENABLE	300-1800 RPM	500 RPM
OVERSPEED	1800-3000 RPM	2500 RPM

CRANKCASE PRESS.	FIXED 8", 10" or 15"	10"H2O
IDLE OIL PRESSURE	5-15 PSI MODULATED	12 PSI
RUN OIL PRESSURE	25-50 PSI MODULATED	42 PSI
IDLE COOLANT PRESS	0-9 PSI MODULATED	3 PSI
RUN COOLANT PRESS.	5-30 PSI MODULATED	15 PSI
TEMPERATURE	65-140° C	100° C
SHUTDOWN DELAY	1-60 SECONDS	20 SECONDS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11.175
[283.8]
7.519
[191.0]
4.625
[117.5]
ENGINE SAVER®
MODEL 550
S/N 08C -
-
● SYSTEM IS ENABLED BY RPM AND/OR TURBO PRESSURE
● ALARM AND DELAYED SHUTDOWN ON LOW OIL, COOLANT PRESSURE, HIGH TEMPERATURE OR AUXILIARY WHEN ENABLED
● ALARM AND DELAYED SHUTDOWN ON HIGH CRANKCASE PRESSURE AT ANY TIME
● ALARM AND IMMEDIATE SHUTDOWN ON OVERSPEED AT ANY TIME
MOUNT WITH THIS ARROW POINTING DOWN
MAIN CONNECTOR
TEMP SENSOR
TEMP SENSOR RETURN
AUX TRIP INPUT
RPM SENSOR
RPM SENSOR RETURN
+24 VDC SUPPLY POSITIVE
SUPPLY NEGATIVE
ACCESSORY CONNECTOR
OVERSPEED EVENT OUTPUT
AUX 2 EVENT
SUPPLY RETURN
+24 VDC SUPPLY POSITIVE
LOW OIL PRESS EVENT OUTPUT
AUX FAULT EVENT OUTPUT
HI TEMP EVENT OUTPUT
COOLANT PRESS. ANALOG OUTPUT
ALARM OUTPUT
OIL PRESS. ANALOG OUTPUT
TEMP. ANALOG OUTPUT
RPM ANALOG OUTPUT
SYSTEM ENABLED EVENT OUTPUT
HI CRANKCASE PRESS. EVENT OUTPUT
LOW COOL. PRESS. EVENT OUTPUT
ANALOG CRANKCASE OUTPUT
ANALOG TURBO OUTPUT
AUX CONNECTOR
AUX 2 INPUT
REMOTE - IF EQUIPPED
REMOTE - IF EQUIPPED
SYSTEM GROUND
FLIGHT SYSTEMS
LEWISBERRY, PA 17339
MADE IN USA
57-5500-48A
31358
POWER
SYSTEM ENABLE
OVERSPEED
HI CRANKCASE PRESSURE
LOW COOLANT PRESSURE
LOW OIL PRESSURE
HI TEMPERATURE
ALARM OUTPUT
AUXILIARY FAULT 1
AUXILIARY FAULT 2
MAIN
AUXILIARY
ACCESSORY
Ø0.438 4 PL
[Ø11.1]
0.500
[12.7]
6.135
[155.8]
TURBO PRESSURE
OIL PRESSURE
COOLANT PRESSURE
CRANCASE PRESSURE
(5 PSI MAX.)

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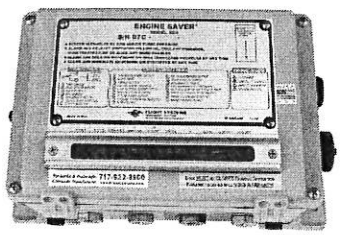
THE THEORY OF ENGINE PROTECTION

By R.D. Shaffner, Chairman/CEO
Flight Systems

Model 550 ENGINE SAVER Development

Level 1, 1980



Level 8, 2008

Almost every diesel engine comes with some form of engine protection factory installed as standard equipment - typically low oil pressure, high RPM and high coolant temperature protection. These are usually simple pressure/temperature activated switches and mechanical governors which require little thought or maintenance. Their location in the primary oil and coolant feed points means they only will alarm when the flow is interrupted - immediately before consequential damage occurs – usually only a few seconds before!

These simple systems rarely false alarm – they also rarely fully protect the engine because their alarm settings are at absolute minimum pressure and maximum temperature settings to cover the widest possible range of applications. The real value of the Engine Saver is it can be adjusted so its alarm conditions are application specific – offering a much greater level of protection. A list of actual in-service fault conditions the Engine Saver "caught" that the factory installed protection ignored makes convincing reading. That list is at the conclusion of this article.

The first job of an Engine Saver is to provide credible engine protection. In order to be credible, false alarms must be eliminated. Otherwise, no one will trust the unit is telling the truth when a real problem develops. The Instruction Manual's very detailed installation and commissioning procedure must be followed in order to achieve the desired results that the Engine Saver was purchased for - - to protect an operating engine before consequential damage occurs.

However, it is possible to "over protect" an engine by:

- *Installing monitoring features not directly involved in your specific application.*
- *Setting alarm "trip points" too close to nominal operating conditions.*

The result - - - an increased chance of false alarms - - - and a loss of credibility.

It is essential to install the Engine Saver's pressure and temperature on-engine sensing in locations which utilize the significant advantage of its trend analysis circuitry. In those instances and unless there are extenuating circumstances, having the Engine Saver monitor functions at the exact same location as the factory installed sensors is not recommended because it duplicates features already in existence. Exactly duplicating engine protection features decreases system reliability.

THE THEORY OF ENGINE PROTECTION *(Cont.)*

Installing the Engine Saver's oil pressure sensing in the piston cooling oil galley has been shown to be a highly effective "early warning" location. Coolant temperature sensing location recommendations are application dependent and vary widely. The optimum location is where the largest change in coolant temperature is first detected. Usually, this is in the cylinder heads or thermostat manifold at the front of the engine. Coolant pressure and crankcase pressure sensing locations are chosen where pressures are at their highest under normal operating conditions. The closest point to the water pump outlet is an ideal coolant pressure sensing point, and a location on any rocker cover works extremely well for crankcase pressure sensing.

There are very few installations where every feature offered by the Engine Saver is recommended to be fully installed and activated. Each installation will vary slightly based on the operational environment the engine being protected must operate in, and the level of protection desired - - To say, "I want everything" while possible, when it does nothing more than duplicate other sensors, increases the chance of false alarms.

Non-catastrophic conditions – momentary interruptions in the supply to the oil pump or coolant pump caused by movement and increases in temperature caused by momentary blocking of the radiator are common non-catastrophic conditions encountered regularly in industrial use.

Overspeed protection saves your engine from damage when a sudden loss of load occurs. The Model 550 sensing system reacts within milliseconds – and is much faster and more accurate than many factory installed governors – many of which are worn, have unknown settings or have no way to test for operation. The overspeed trip point is adjustable between 1800RPM and 3000RPM

MARINE – If yours is a marine application, All marine engines ultimately depend on sea water (a.k.a. Raw Water) through a heat exchanger instead of air through a radiator to get rid of the heat of combustion. The result is much more effective cooling.....as long as water is moving through the heat exchanger. The most common fault of marine applications is loss of sea water flow due to failed pump, dirt blocking the heat exchanger or an obstruction – something as common as a fish or plastic bag jamming the through hull intake. It is recommended you purchase a Flight Systems Model 612 Sea Water Flow Monitor which is specifically designed for this application. Please note: For Detroit Diesel 8V, 12V or 16V 71, 92 or 149 series marine engines, Flight Systems offers a unit specifically tailored for these engines – Our Model 551 Marine Engine Saver.

The Engine Saver includes "look again" circuitry to prevent alarms when transient conditions exist for 10 seconds or less, but if your installation has circumstances which allow deviations in the normal pressures or temperatures longer than 10 seconds, the Engine Saver internal settings must be adjusted to reflect that. The normal operational temperature and pressure changes throughout the seasons and over the service life of the fluids they are monitoring also will affect the trip point.

The oil pressure of newly installed motor oil in the service shop at room temperature is far different from the oil pressure of old motor oil at the end of a hard run on a hot day; or an engine which has set outside and un-run for a weekend in the middle of winter. Also, old water pumps and oil pumps do not put out the same pressure as new water pumps and oil pumps. A regular check of the exact settings for alarm conditions after taking into account the full range of "normal operating and pump conditions" will eliminate false trips due to non-catastrophic factors.

The Engine Saver trip points must be set to not alarm in those instances when the surrounding environment is in its worst case condition - - setting trip points at the minimum normal DC input voltage, maximum engine acceptable operating temperature and with other electrical and electronic equipment normally in service in the operating environment will assure accurate protection and eliminate many of the common causes of false alarms. If the engine is run at constant RPM or within a narrow RPM range - - as in power generation - - turbo boost enabling is recommended. It would not be necessary to install the RPM sensor in this instance unless the factory-installed overspeed protection is not present or inadequate.

The Engine Saver embodies very sophisticated electronic sensing circuits which will assure elimination of internally induced false alarms, but the installation must be made with the realization that the Engine Saver receive supply voltage (the battery connection) relatively free from externally induced spikes or interference, and that the Engine Saver is mounted in a position away from severe heat and vibration – in other words don't mount in a closed engine compartment where the air temperatures are well in excess of 100°C, etc. The best location for mounting the Engine Saver is either in the operator's cab or another location external to a closed engine compartment – even outside "in the weather", while hardly optimal, is preferable to inside a tightly closed engine compartment.

After the Engine Saver is properly mounted and the protection features have been selected, the actual measurement of coolant pressure is required to properly set the trip point. These measurements will vary from installation-to-installation and from engine-to-engine based on the age of the engine, the cleanliness of the cooling passages, condition of the water pump and radiator. It is highly recommended to replace the radiator pressure cap during the installation. Radiator pressure caps weaken with age and will lower coolant pressure.

The coolant pressure trip point measurement must be made with a pressure gauge (Flight Systems' Model 9550 Engine Saver Test Set or equivalent) measured from an actual running engine that is considered in acceptable operating condition with a new or perfect radiator cap.

The Engine Saver uses pressure transducers which monitor the actual coolant and oil and, therefore, is subjected to the same dirt and impurities found in the oil and coolant fluids during normal operation. As a result, these transducers must be included in the regular PM cycle to make sure they are operational and not corroded or clogged with debris.

At least once every 6 months, each hose should be disconnected at the Engine Saver, gauge checks should be made showing the actual pressures and the pressure transducers drained and checked for accumulation of solids. It is also essential to know that the pressure transducers actually read minimum pressure when the engine is not running. A build-up of sludge caused by improper mounting (Engine Saver mounted below the engine, or with its pressure ports facing any way but down) or poor filtering can cause the transducers to fail to sense minimum pressure -- and never alarm!

THE THEORY OF ENGINE PROTECTION

Coolant and oil pressure transducers are recommended to be changed out every 10,000 engine hours or two years, whichever occurs first. A few operational checks of each alarm should be made on an enabled Engine Saver every year. These PM steps will assure that all alarm functions are operational and trip point settings have not degraded.

The Engine Saver is designed to react and remember the first fault. The true value of the Engine Saver would be severely diminished if it showed more than one fault because it would be very difficult to diagnose which fault happened first. The Engine Saver will keep the first fault condition in its memory and on display as long as power is kept supplied to the unit. Here are two examples:

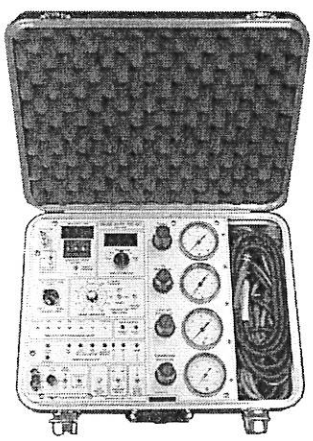
Example 1 - Insufficient coolant flow caused by low coolant level, defective or worn pump. This fault will be caught by the coolant pressure sensor before the coolant overheats and the overtemperature sensor trips. The information would be far more useful to the operator and to the life of the engine to diagnose and correct the first fault - low coolant pressure than to have two faults displayed - low coolant pressure and high coolant temperature.

Example 2- If a piston ring fails or a hole burns in a piston due to a partially clogged injector, the first alarm condition will be an increase in crankcase pressure. The second alarm will result when the increased crankcase pressure blows the oil out of the crankcase, resulting in a low oil pressure alarm. Again, there is far less consequential damage to the engine by reacting to the first alarm, which is what the Engine Saver does.

Since 1980, the Engine Saver has earned the loyalty of many owners and operators of hard working diesel engines because it has detected problems before consequential damage occurred -- problems that went otherwise undetected! Proper installation and regular PM go hand in hand with the Engine Saver's success.

Issued April, 2009.

A list of "Saves" -- typical harmful conditions detected by the Engine Saver appears on the following page.



Flight Systems
Model 9550
ENGINE SAVER®
TEST SET

List of "SAVES" - Engine Conditions Caught by The Flight Systems ENGINE SAVER®

OIL SYSTEM FAULTS

Low Oil Pressure or Gradual Loss

- *Sticking regulator*
- *Clogged oil filter*
- *Wrong viscosity/high ambient*
- *Excessive bearing wear*
- *Internal leak(s)*
- *Oil foamed or fuel diluted*
- *Excessive heat from transmission coolers*

No Oil Pressure or Sudden Loss

- *Broken pump shaft*
- *Broken regulator spring*
- *Ruptured line*
- *Massive oil loss or no oil*
- *Pump intake blocked*
- *Missing oil pump bushing*

COOLING SYSTEM FAULTS

Gradual, Partial or Intermittent Loss

- *Damaged pump impeller*
- *Slipping pump drive*
- *Flow restriction*
- *Internal/external leaks*
- *Radiator cap loose/defective (Reduced press.)*
- *Blocked radiator air flow*
- *Aeration or drawing air*
- *Defective thermostat*

Sudden or Large Loss

- *No coolant*
- *Bottom radiator hose*
- *Filler cap comes off (Sudden pressure release)*
- *Pump failure*
- *Broken belt or shaft*
- *Thermostat stuck closed*

CRANKCASE PRESSURE FAULTS

- *Broken piston*
- *Scored cylinder*
- *Broken rings*
- *Seized valve guide*
- *Improper top overhaul*
- *Oil soaked breathers*
- *Overfilling/forming/dilution*
- *Broken injector pipe*
- *Head Gasket*

I M P O R T A N T -

WARRANTY INFORMATION

Flight Systems Model 550 ENGINE SAVER®

The MODEL 550 ENGINE SAVER® is warranted to be free from defects in materials and workmanship for a period of two years from the date of shipment, or the date it is first put into service, if the latter is documented by completing and returning a copy of the WARRANTY REGISTRATION (On the following page) within *10 DAYS OF INSTALLATION*.

FLIGHT SYSTEMS' liability is limited to the repair of replacement of defective product within the warranty period, and does not cover installation or removal costs incurred or possible damage to other equipment (including engines or parts thereof) as a result of a malfunction of the ENGINE SAVER.

If, in the opinion of FLIGHT SYSTEMS (or its authorized agent) the malfunction of the ENGINE SAVER was caused by abuse, misuse or improper installation, the warranty claim will be disallowed and established repair rates shall apply.

Units should be shipped, freight charges prepaid, directly to *FLIGHT SYSTEMS, 207 Hempt Rd, Mechanicsburg PA 17050 USA Attn: M & I Repair*, or any of the authorized agents listed in this publication (see Pg. 34).

N O T E :

IN ORDER TO ACTIVATE YOUR WARRANTY, FILL OUT AND RETURN THE ENGINE SAVER / WARRANTY REGISTRATION ON THE NEXT PAGE.

ENGINE SAVER
WARRANTY REGISTRATION

Please fill out the information below, and Fax, or Mail to:
Flight Systems 207 Hempt Road, Mechanicsburg, PA 17050 USA

PLEASE PRINT CLEARLY

COMPANY_____ DIVISION_____

ADDRESS _____

CITY_____ STATE_____ ZIP_____ COUNTRY_____

PHONE_____ FAX_____

CONTACT NAME_____TITLE _____

E-MAIL _____

APPLICATION INFORMATION

ENGINE SAVER S/N _____ **DATE OF INSTALLATION** _____

EQUIPMENT MAKE _____ **MODEL** _____

ENGINE_____**CONDITION**_____ **HOURS** _____

APPLICATION: **[ ] MINING** **[ ] MARINE** **[ ] STANDBY POWER** **[ ] EARTH MOVING**

[ ] OTHER (Please Describe) _____

INSTALLATION

INSTALLED BY: **[ ] OEM** **[ ] DEALER** **[ ] FS AGENT/DIST** **[ ] OWNER/USER**

COMMENTS:

This Form May be Faxed Toll-Free (USA & Canada) to: 800-333-9912
(International FAX: 717-590-7327)

MODEL 550 GENERAL SPECIFICATIONS

SUPPLY VOLTAGE:
24 VDC Nominal - 18V Min. 28 V Max
Transient Voltage Protection to 100 VDC

UNIT TEMPERATURE RANGE:
-40 C to +85 C Operating
-55 C to +125 C Storage

TEMPERATURE SENSOR:
30,000 Ohms @ 25 C, NTC

RPM INPUT SENSORS:
Reluctance Magnetic Pickup
Alternator "R" Terminal
Tachometer Generator

OIL PRESSURE INPUT:
1/8 NPT Female Port
5 PSI Min to 100 PSI Max.

COOLANT PRESSURE INPUT:
1/8 NPT Female Port
0.5 PSI Min to 50 PSI Max.

TURBO PRESSURE INPUT:
1/8 NPT Female Port
0 PSI Min to 50 PSI Max.

CRANKCASE PRESSURE INPUT:
1/8 NPT Female Port
0 INS. W.C. Min to 50 INS.W.C., 5 PSI Max.

TRIP INPUTS:
AUXILIARY FAULT 1 - Switch Closure to+24V.
AUXILIARY FAULT 2 - Switch Closure to System GND.

ELECTRONICS:
Encapsulated, Repairable

CONNECTORS:
Military Type, Metal

ENCLOSURE:
NEMA Type 4.

ANALOG OUTPUT VOLTAGES:
Designed for Resistive Type Loads
0-5 VDC, 1 mA Max.
Output Source Impedance Typically 5 ohms

EVENT OUTPUT SIGNALS:
Switch Closure to System GND, 24 VDC, 500 mA Max., Withstand 60 VDC

OUTPUT RELAY:
SPDT, Contacts Floating
10 Amps Resistive Loads at 24 VDC.
8 Amps Inductive Loads at 24 VDC.

FLIGHT SYSTEMS
717-590-7330 www.flightsystems.com

ENGINE SAVER® MODEL 550 INPUTS & OUTPUTS

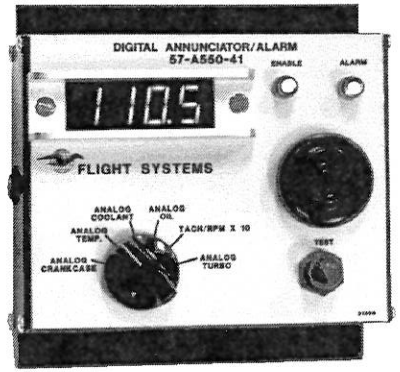
POWER (24V) INPUT
RPM SIGNAL INPUT
TEMPERATURE INPUT
AUX. FAULT "1" TRIP INPUT
RELAY OUTPUTS (SPST)

Note: *Faults 1 & 2 are Customer Optional Inputs*

ANALOG OUTPUTS
There are 6 Analog Outputs for Real-Time Monitoring or Recording of Engine Parameters.

*Note: *TURBO & CRANK-CASE available ONLY with Auxiliary Board Option (P/N 57-A550-93)*

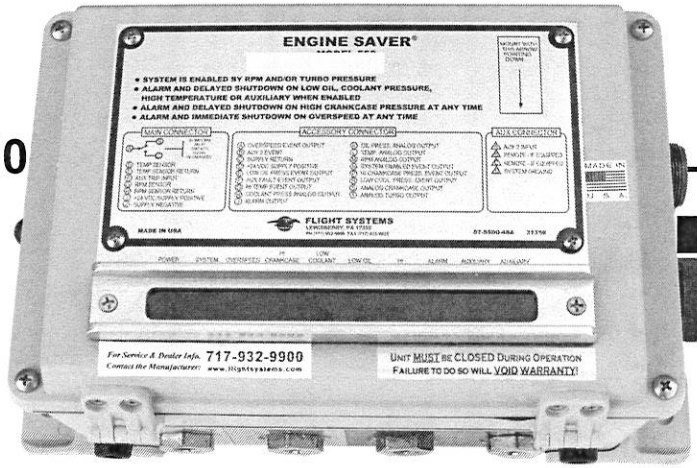
RPM
COOLANT
OIL
TEMPERATURE
*TURBO
*CRANKCASE
ALARM
ENABLE



DIGITAL ANNUNCIATOR / ALARM P/N 57-A550-41

MAIN HARNESS

MODEL 550 ENGINE SAVER®



ACCESSORY HARNESS

24 VOLT OUTPUT
SYSTEM ENABLE
OVERSPEED
HI CRANKCASE PRESSURE
LOW COOLANT PRESSURE
LOW OIL PRESSURE
HI TEMPERATURE
AUXILIARY FAULT 1
ALARM
AUXILIARY FAULT 2

EVENT OUTPUTS
There are 8 Event Outputs available for operating Remote Indicators and/or Remote alarm devices.

Note: *Faults 1 & 2 are Customer Optional Inputs*

TURBO
OIL
COOLANT
CRANKCASE

PRESSURE LINES FROM ENGINE

AUXILIARY HARNESS 2

AUXILIARY FAULT TRIP (2) INPUT
REMOTE RESET

"E"

SELECTING A LOCATION

GENERAL: *Several factors should be considered when selecting a location for the Model 550 Engine Saver to ensure maximum usefulness and trouble-free operation. The chosen locations should provide all of the following:*

1. PROTECTION: Reasonable protection from physical damage, high temperatures, or heavy soil buildup on the unit.

2. ACCESS: Easy access for service personnel.

3. TAMPERING: Resistance to operator tampering or willful damage.

4. MOUNTING: Substantially higher than the engine pick-off points for the Oil, Coolant, and Crankcase Pressure Lines.

5. LOCATIONS: Such as wheel well and tightly closed engine compartments should be avoided if possible. The chance of damage due to flying rocks, heavy soils (sometime highly corrosive) or excessively high temperatures are greatly increased in these areas.

6. VISIBILITY: The location and mounting position should allow the indicators to be clearly visible and the cover to be fully opened.

7. DRAIN: Pressure lines must drain away (downward) from the unit. Low spots and loops in pressure hoses are to be avoided for reasons explained below.

8. IMPORTANT - ***THE UNIT MUST BE MOUNTED WITH THE PRESSURE CONNECTIONS FACING TOWARD THE GROUND.***

NOTE 1: **Reasons the ENGINE SAVER must be mounted with Pressure Connections facing the Ground.**

A. Avoiding solids entrapment in pressure lines and sensor inlet ports.
B. Avoiding false relay actuation due to mechanical shocks in the vertical plane.
C. Ensure proper operation of case drain and vent system, to prevent moisture buildup inside the unit.

NOTE 2: Although severe shock and vibration transmitted directly to the unit is detrimental over the long term, a small amount of vibration is beneficial as it tends to reduce the deadband or hysteresis in the pressure sensors and results in more accurate pressure sensing.

MOUNTING AND PRESSURE CONNECTIONS

1. UNIT MOUNTING: The unit is to be securely fastened by its mounting flanges (four 1/4 inch bolts), with its pressure connection side DOWN. Use locking or vibration resistant hardware.

2. PRESSURE HOSE: Pressure connections maybe made to the engine by means of armored flexible hose, AEROQUIP 1503-4 (SAE100R5 rated) or equivalent, except for *Coolant Pressure Hose. This should be a Teflon Metal Jacketed Hose such as Everflex..*

3. MARINE APPLICATION: When installing Engine Saver on a Marine Engine, COAST GUARD APPROVED hose may be required for certification. In these installations, use AEROQUIP FC234-5 (SAE J1942-1 & SAE J1527A1) hose.

4. FITTINGS: Use suitable adapter fittings at each end of each line, terminating in a 1/8 inch male pipe thread (NPT) at the Engine Saver end. Swivel type fittings should be used on all flexible hose connections. In many instances, a 45 or 90 degree fitting improves the neatness and durability of the installation. Sometimes a reducing bushing is required.

5. CAUTION REUSING FITTINGS: Use caution when installing reusable type fittings on the flexible hose. Sometimes a small piece of rubber may be shaved from the inside of the hose by the tail of the fitting. These pieces can block the line or sensors and cause false tripping. This is critical on the crankcase pressure line due to its very low operating pressure.

6. COMPOUND: Use Teflon pipe compound on all connections. (Teflon tape is not recommended)

7. TIGHTENING: IMPORTANT! When tightening, support the 7/8" hex on the unit with a wrench (spanner) in order to prevent the fitting in the unit from turning. Tighten snugly, but do not over tighten, as the threads may be damaged. Make certain all fittings & threads are clean before final assembly, and that no pipe compound lodges inside the lines, fitting or adapters.

8. METAL TUBING: If metal tubing is used, make certain that the proper flare or compression fittings are installed for the type of tubing being used.

9. TUBING BENDS: Make certain that all tubing bends are smooth and that no kinks or dents are present.

10. SUPPORT: Long runs of pipe, tubing or hose should be supported in several places to avoid excessive movement in high-vibration areas. Use clamps that are cushioned or lined with rubber.

11. BULKHEAD FITTING: In places where hose passes through a bulkhead or near a sharp object, a rubber grommet or bulkhead fitting must be provided to prevent chafing.

12. TUBE DIAMETER: All tubes or hoses must have a minimum inside diameter of 3/16 inch.

CAUTION! **Use extreme care in connecting, and properly identifying the various lines, as a wrong connection will cause improper operation or permanent damage. Use metal identification tags for each hose connection to the box. Under no circumstances should the pressure on the crankcase sensor be allowed to exceed 5 psi.**

PLUMBING

• PICK-OFF POINTS

GENERAL: Hose or Tubing connections are to be made to the Engine's Turbo, Oil, Coolant and Crankcase pick-off points. If possible, route the Oil and Coolant Pressure lines such that there is vertical or upwards slanting section of line as it leaves the connection point on the engine.

• OIL PRESSURE

1. LOCATION: The pressure pick-off point is placed at the source of piston cooling oil since this is most critical. Protection is assured over the full operating range.

2. TAP: Locate tap on Pressure Piston Cooling Nozzle or its gallery farthest from the oil source. If not equipped with direct piston cooling *(such as DETROIT DIESEL)*, then use tap on Main Oil Gallery either side of engine.

• COOLANT PRESSURE

1. LOCATION: The pressure pick-off point is critical, and MUST be at the Pump Outlet, or in the block closest to this point.

2. TAP: Locate tap as close as possible to Water or Block Pump Outlet or Oil Cooler Water Inlet if fed directly by pump. *DO NOT connect to Pump Inlet, By-Pass Loop, Cylinder Head or Thermostat Housing as these points will result in false information.*

• TURBO ENABLE

1. OPTIONAL: The use of Turbo Pressure enable is entirely optional and this decision is deferred to the installer. If it is not used, the Pressure Port should be Plugged.

2. LOCATIONS: The pressure pickoff point is placed at the source of turbo pressure. Locate tap on Blower Outlet of Turbo-Charger Outlet downstream of aftercooler (if equipped) air crossover pipe or any air box cover. NOTE: It is OK if some oil vapor enters the turbo pressure line. This will not cause a false trip.

3. SETTING: The Engine Saver can be equipped with a Turbo Pressure Sensor that is factory set at 15 inches Hg. (Non-Adjustable). Units fitted with the AUXILIARY board have an Analog Transducer installed, and can be adjusted over a range of 8-25 PSI).

4. ENABLING: In most applications, Turbo Pressure has proven to be a good backup or auxiliary means of enabling the Oil & Coolant Pressure monitoring functions of the Engine Saver, when normal RPM sensing is lost.

• CRANKCASE PRESSURE

1. LOCATIONS: The pressure pickoff point measures c.c. pressure as high as possible on the engine. Locate tap on any rocker (without a breather) on a valve cover or on the side of the fill pipe if well above the oil level. *Oil must not enter this line. Line must drain back toward engine tap point with no low spots or loops.*

ELECTRICAL

• RPM SENSING GENERAL

1. RPM SENSING: In order to sense engine RPM, an RPM pickup of some type must be fitted. Engine RPM is monitored by one of the following:

A. Flywheel Pickup (Magnetic pickup on bell housing)
B. Tachometer Generator (On cam shaft or injector pump)
C. Alternator Pickup ("R" Terminal)

The choice of RPM Sensing method to be used in a given installation depends on the availability or accessibility of a Flywheel or Cam Gear pickup mounting site or a take-off point for a Tachometer Generator. An existing Tachometer Generator can be "shared" by the Engine Saver if the installation meet the following criteria:

A. ***Generator impedance is below 1000 Ohms.***
B. ***AC output only (NO DC component).***
C. ***Generator is "Floating" from Frame or Battery.***
D. ***Output is at least 8 Pulses/Revolution.***

If a flywheel pickup or tach generator is not practical, an alternator provides a very simple means of obtaining an RPM signal without the need to install any additional devices on the engine.

• VARIABLE RELUCTANCE MAGNETIC SENSOR

1. GENERAL: The speed of the engine can be sensed by a variable reluctance pickup mounted in close proximity to the Flywheel Ring Gear or Cam Gear *(Figure 1, below)*.

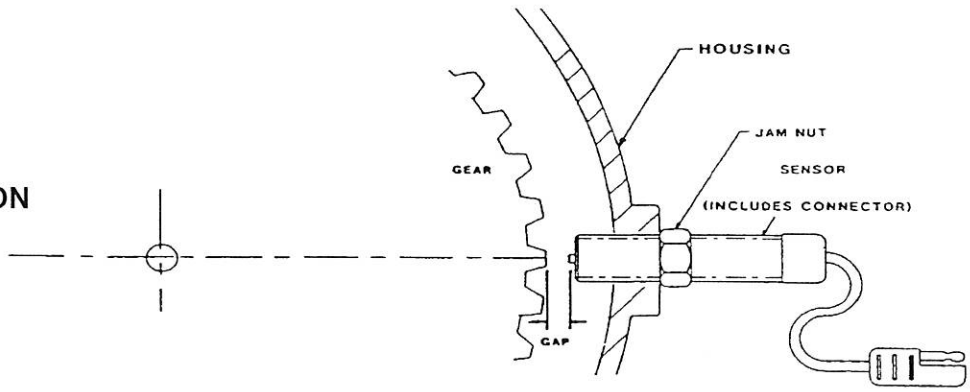
2. CAM GEAR SENSING: In cases where it is inconvenient to use the Flywheel Ring Gear for the RPM Pickup, a Cam Gear with fewer teeth (typically 68) may be used.

3. MOUNTING: The RPM Sensor mounting hole is already provided on many engines by removing a plug in the Flywheel or Cam Gear housing at the rear of the engine. The threaded hole may not already be 5/8-18 UNF (SAE), or maybe a larger diameter (such as 7/8 or 1 inch). In these cases a reducing bushing or a different Mag Pickup is required. If it is necessary to drill and tap a mounting hole, be certain that the hole is located on the gear centerline, at right angles to the shaft, and that there is adequate metal thickness at the chosen location. (Be sure to use caution to prevent metal shavings from falling into bell housing, or genset if exposed)

4. AIR GAP: For proper performance, the air gap between the sensor pole piece ("button" on end of sensor) and the gear teeth must be set at 0.20-.040 inches (0.5-1.0 MM). Since the sensor should never be allowed to touch the gear while it is turning, the gear run-out must be taken into account when setting this gap. It is suggested that the gear be rotated until the point closest to the sensor is found, then thread the sensor in (CW) until it touches the gear tooth, Then back the sensor out (CCW) one-half of a turn, and lock it in place.

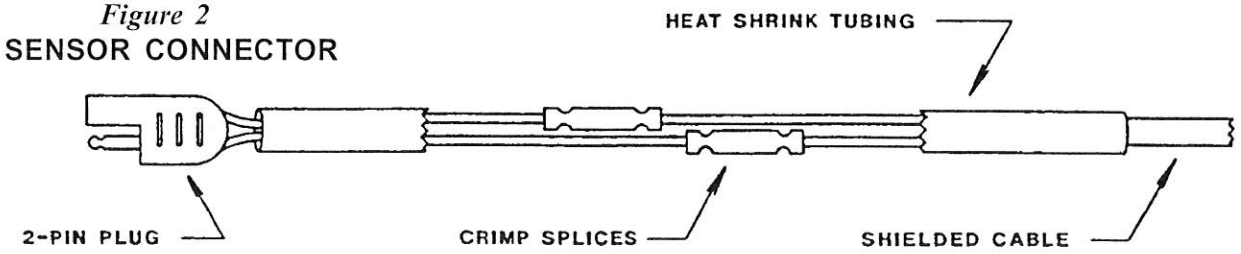
5. ELECTRICAL: Electrical connection is made by means of a 2-pin weatherproof rubber connector (furnished with the sensor) that mates with the connector on the rear of the sensor. This connection is to be attached to the end of the shielded-pair cable that is a part of the installation harness furnished with the Engine Saver. After cutting to the proper length, trim shield flush with end and pull the jacket over to insulate shield.

Figure 1
SENSOR LOCATION



6. SHRINK TUBING The 2-pin rubber connector has short leads already attached and molded in. This connector is joined to the black and clear wires by means of crimp splices (soldering if desired). If solder is used, each finished connection must be insulated with heat shrinkable tubing. An overall jacket of heat shrink tubing is desirable with either method as an added protection. *(Figure 2, below)*.

Figure 2
SENSOR CONNECTOR



• TACHOMETER GENERATORS

1. GENERAL: If a tachometer signal is not already supplied to other instrumentation (which the Engine Saver can use), a popular and convenient means of RPM sensing is the tachometer generator. It is a small, rugged, permanent-magnet AC generator that is driven from a take-off on the accessory drive cover, camshaft or injector pump shaft.

2. MOUNTING: A variety of mounting adaptors and drive couplings (or drive tangs) are available to permit use on any engine. The most common take-off configuration is a 7/8-18 SAE male thread.

3. VERSIONS: Other versions include General Motors flange mount (accessory drive and blower drive) as well as a metric M22X 1.5 thread. Various drive shafts (including E1/E2 Din 75 532 Metric) are also available.

4. TAKE-OFF POINTS are usually provided, and no modification of the engine is required. Some engine manufacturers use a take-off to drive a mechanical service hourmeter. A tachometer drive take-off may be created by installing a T-drive adaptor between the engine and the hourmeter.

5. FEED-THRU: On engine equipped with only a single take-off that is already used to drive an existing device such as a mechanical tachometer, a "feed-thru" style of tachometer generator is needed. This allows the existing tachometer drive cable to be re-connected to the opposite end of the tachometer generator. *(See Figures 3 & 4 below)*

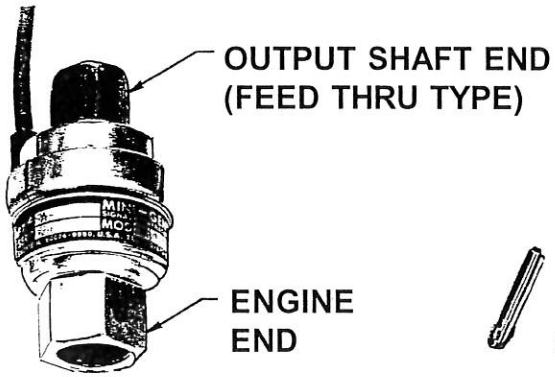
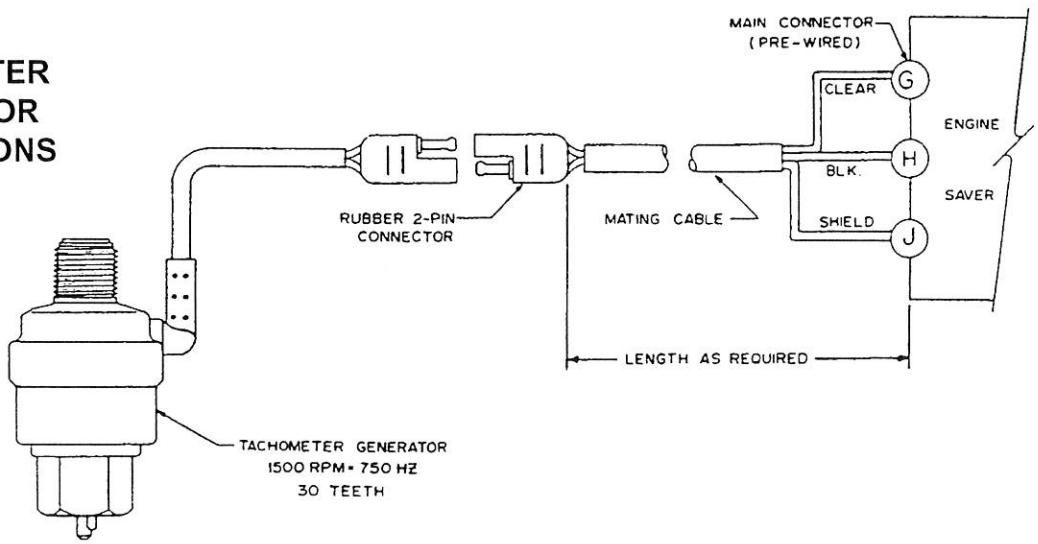


Figure 3

Figure 4

SEE ACCESSORY LIST AT THE BACK OF THIS MANUAL FOR COMPETE ORDERING INFORMATION ON TACHOMETER GENERATORS, MOUNTING ADAPTERS, DRIVE TANG KITS & CONNECTING CABLES.

Figure 5
TACHOMETER GENERATOR CONNECTIONS



• ALTERNATOR TACHOMETER OUTPUT

1. GENERAL: Nearly all modern heavy equipment and diesel power plants utilize an alternator for Battery Charging. Most of these alternators have a special electrical output terminal ("R" terminal) for operating a tachometer. This eliminates the need for installing a magnetic pickup or tachometer generator, where these may not be convenient or possible. If this "R" Terminal is tried and does not work initially you have to use one of the other sources.

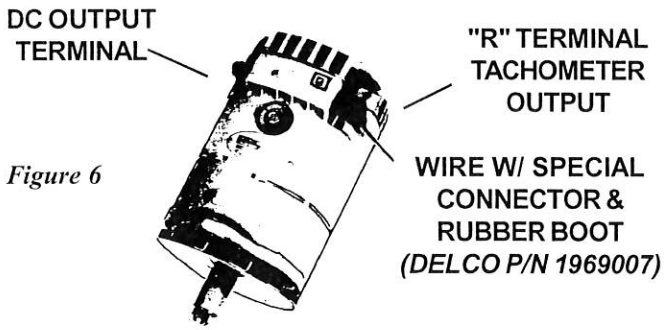


Figure 6

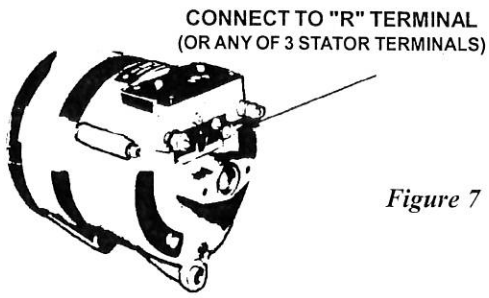


Figure 7

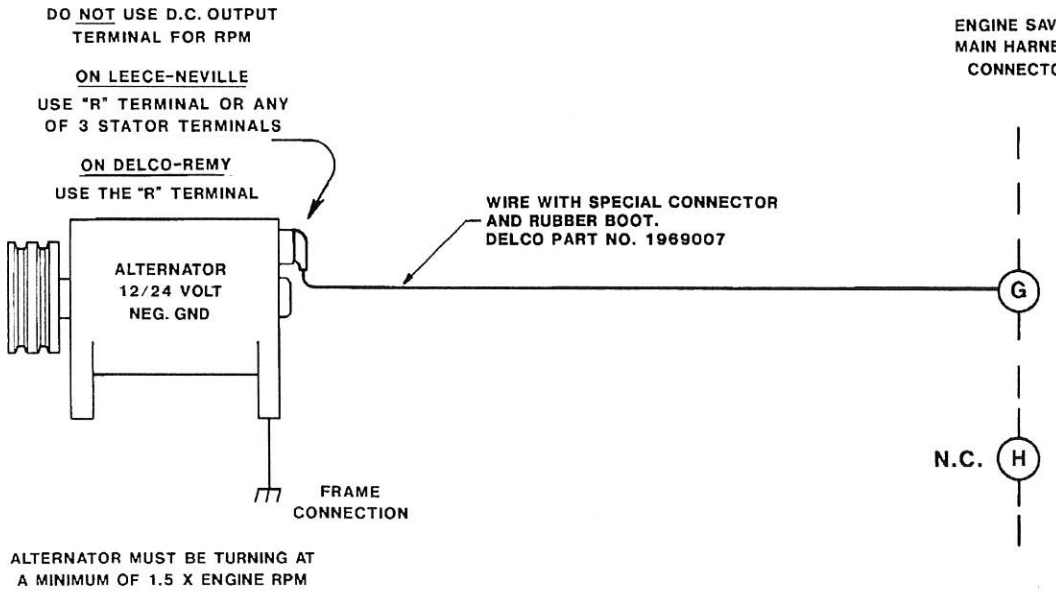


Figure 8
WIRING DIAGRAM FOR ALTERNATOR RPM PICKUP

• COOLANT TEMPERATURE SENSOR

1. LOCATION: Install the sensor (Supplied) at the appropriate location on the engine. We recommend installing the sensor before the Thermostat Manifold or in the head where engine coolant temperature is being monitored *(Do NOT install in Water Jacket at Rear of Engine)*.

2. SIZE: The brass body has a 1/2 inch NPT thread, with a one inch hex nut. If the sensor is to be installed in a smaller hole optional 3/8 inch or 1/4 inch NPT sensors are available.

3. LIQUID CONTACT: Make certain that the liquid will come in full contact with the sensor.

4. ELECTRICAL: Electrical connection is made by means of a two pin military connector. These connections are *NOT* polarized.

5. CONNECTION: The temperature probe wires are connected to Pin D (Yellow) and E (Violet) of the MAIN connector.

6. ELECTRICAL NOISE: If electrical noise is extreme, wires should be run with a twisted shielded pair such as that used on the RPM sensor.

7. ROUTING: Be careful that electrical wires are away from Stacks, Turbos, Exhaust Manifolds or any source of electrical interference such as Alternator/Starter Cables.

IMPORTANT: IF TEMPERATURE SENSING IS NOT USED, THE TEMPERATURE INPUT CANNOT SIMPLY BE LEFT UNWIRED OR OPEN BECAUSE OF THE FAIL-SAFE FEATURE. ***If the temperature sensor is not used, place a 4.7K resistor between pins D & E to avoid an open sensor fault.***

• RELAY

GENERAL: The relay in the unit is a single-pole, single throw (SPST) with contacts rated at 30 amperes, resistive load. These contacts are floating from the supply power & internal circuitry, and may be wired in any configuration suitable to the application. *(Typical wiring diagram shown in Fig.11, Pg. 8)*

1. CONNECTIONS: If he relay common contact is connected to the positive 24 Volt supply, as shown, the normally open contact maybe used to supply power to the Fuel Valve.

THE NORMALLY CLOSED CONTACT can supply 24 Volts to a Remote device.

DE-ACTIVATION of the Relay then turns on the Remote Device and turns off the Fuel.

2. REMOTE RESET: If remote reset is desired, a normally closed momentary switch may be included in series with the fuse, and the +24 Volt supply to the Engine Saver as shown in Figure 12, on Pg. 9. Optionally, remote reset may be accomplised via the auxiliary connector.

• ALARMS OUTPUT

Audible alarms, LED indicators and interconnect cables are available for custom panel installations or to accommodate existing Annunciator Panels. Refer to optional parts listing at the end of this manual.

• ANALOG OUTPUTS

AT NO TIME SHOULD VOLTAGE BE APPLIED DIRECTLY TO THE ANALOG OUTPUTS OR DAMAGE WILL RESULT. See Outline Drawing *(Figure 12, Pg. 9)* for additional information.

GENERAL: Four Analog Outputs -- RPM, OIL PRESSURE, COOLANT PRESSURE and TEMPERATURE -- allow continuous real-time monitoring and/or recording of engine parameters by another system connected to the Engine Saver. (These can be expanded to include analog TURBO, and CRANKCASE PRESSURE when the AUXILIARY board is installed). These outputs are pre-scaled to the industry standard 0-5 VDC for Analog Data, and are designed to feed a system with high impedance inputs. The output source impedance of each output is typically 5 Ohms.

1. OUTPUTS: The Analog Outputs may be connected to other on-board systems that record engine parameters over an extended period for the purpose of maintenance scheduling and/or trend analysis. The data may also be telemetered (by radio link) in "real time" to a central location for continuous storage and/or monitoring by a computer.

2. CONNECTOR: The Analog Outputs are available on the 17-Pin MS Connector marked "ACCESSORY".

1. RPM Analog Signal 3000 RPM = 5.0 VDC (Pin "M")
2. OIL PRESSURE Analog Signal 72 PSI = 5.0 VDC (Pin "R")
3. COOLANT PRESSURE Analog Signal 30 PSI = 5.0 VDC (Pin "A")
4. TEMPERATURE Analog Signal (Pin "L") see table 6.
5. TURBO PRESSURE Analog Signal 25 PSI = 5.0 VDC (Pin "T")
6. CRANKCASE PRESSURE 15 INS. W. C. = 5.0 VDC (Pin "S")

• EVENT OUTPUTS

GENERAL: Each EVENT output appears as an open circuit when it is not activated. When activated, the output is switched to common "Negative", and will handle up to 1/2 Amp, at 24 VDC. All event outputs are designed for resistive type loads such as LED's or incandescent lamps.

AT NO TIME SHOULD VOLTAGE BE APPLIED DIRECTLY TO ANY EVENT OUTPUT OR DAMAGE WILL RESULT. See diagram for "Typical Wiring of the Accessory Connector", *(Figure 15, Pg. 11)* and *(Table 2, Pg. 10)*.

• AUXILIARY FAULTS, INPUT WIRING

GENERAL: There are two Auxiliary Fault inputs, AUXILIARY FAULT (1), and (2). These Channels may be used to monitor additional functions which may not be directly related to engine operation.

1. **AUXILIARY FAULT(S)** are activated, typically from a switch closure.
   A. AUXILIARY FAULT 1 is activated by applying +24 Volts to pin "F" (Gray) on the MAIN CONNECTOR.
   B. AUXILIARY FAULT 2 is activated by applying GROUND to pin "A" (ORG) on the AUXILIARY CONNECTOR.
2. **NON-FAULT:**
   A. Auxiliary Fault "1" no-fault condition may be zero volts or simply an open circuit.
   B. Auxiliary Fault "2" no-fault condition may be +24 Volts, or an open circuit.
3. **ENABLE:** Can be Enabled ALL the time via a dip switch or, enabled by RPM . *(See Fig. 17, Pg. 12 & Table 5, Pg 14)*.
4. **NOT USED:** The auxiliary inputs may be left unwired if not used.

• POWER WIRING

1. SUPPLY: Power to the unit should be supplied directly from the Battery Connector via a 1 Amp. Control Fuse. If this unit is fitted with the AUXILIARY board, a 1-Amp CONTROL fuse has been added to the board. Also see Accessory Connector.

NOTE 1: The control of power to this circuit should NOT be accessible to the operator. If it is, the unit can be reset and the "TELL-TALE" indication will be lost.

2. RESET: A Reset Switch accessible only to maintenance personnel is provided inside the unit.

• ELECTRICAL CONNECTIONS*

Only the Main Harness can be connected when vehicle is in motion - no other harnesses are to be connected to the module.

GENERAL: The electrical connection of the Engine Saver to the vehicle or equipment is straightforward and done by means of three Military type (MS) connectors.

CAUTION: AVOID THE USE OF AN ELECTRIC ARC WELDER IN CLOSE PROXIMITY TO THE ENGINE SAVER OR A WELDING OPERATION ON A PART OF THE VEHICLE FRAME TO WHICH IT IS MOUNTED. THE VOLTAGES PRESENT MAY CAUSE DAMAGE TO THE ELECTRONICS OF THE ENGINE SAVER. IF WELDING IS NECESSARY, DISCONNECT THE ELECTRICAL CONNECTOR(S) AT THE ENGINE SAVER BEFORE PROCEEDING. PROTECT ALL ELECTRICAL WIRING FROM SPARK DAMAGE DURING WELDING.

1. MAIN 10-PIN CONNECTOR: The Main 10-Pin connector carries the circuits for 24 Volts Power, RPM Sensing, Temperature Sensing, Auxiliary Fault 1 and the Output Relay Contacts, (for Alarm, and Shutdown devices, etc.).

2. ACCESSORY 17-PIN CONNECTOR: The 17-pin Accessory connector carries the circuits for the 6 engine "Events", Auxiliary Fault "1" "Event", 4 Analog Outputs. (If the Auxiliary Board is installed Analog Turbo and Crankcase pressure is available), and an Alarm Output. *(See Table 2, Pg. 10).*

3. AUXILIARY 4-PIN CONNECTOR: The 4-pin Aux. connector carries the input/output circuits for Auxiliary Fault 2 and remote reset.

4. HARNESS: The electrical connection of the Engine Saver to the machine or vehicle is simplified through the use of the 12-foot pre-wired harness assembly supplied. (Other harness lengths are available)

5. LENGTH: The wires or cables may be cut as required to fit each installation, with the various wires brought out at points along the harness.

6. ROUTING: Care should be taken to route the cable in a protected area away from hot objects such as exhaust manifolds, turbochargers, stacks, etc., or where it might be accidentally stepped on or used as a hand grip by operating or maintenance personnel. We suggest using flexible conduit or similar protection for wiring.

7. MAIN POWER SWITCH: The main power switch inside the unit is set to **"off"** from the factory. Switch it to **"on"** after making electrical connections

• MAIN HARNESS

1. HARNESS: The harness consists of a mating 10-pin MS plug, eight No. 18 AWG stranded color-coded wires and a shielded, twisted-pair cable (Provided with ENGINE SAVER).

2. FUNCTIONS: The circuits to be connected are:

A. Supply Power to the unit (24 VDC).
B. Relay Contacts as necessary for operation of Alarms, Fuel Restricting Devices, etc.
C. RPM Sensor.
D. Temperature Sensor.
E. Auxiliary Trip input 1 (Optional).

IMPORTANT: IF TEMPERATURE SENSING IS NOT USED, PINS D AND E ON MAIN CONNECTOR MUST HAVE RESISTOR CONNECTOR SEE PAGE 5, COOLANT TEMPERATURE SENSOR STEP 8 & 9.

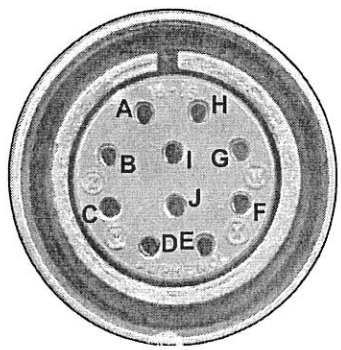
3. MS PLUG: The connector pins are identified by letters, with the function of each indicated on the unit's front cover.

Table 1 - **MAIN CONNECTOR WIRING**

MSPIN	WIRECOLOR	FUNCTION	
A	Brown	Relay K1-A Common	
B	Green	Relay K1-A N.C.	
C	Blue	Relay K1-A N.O.	
D*	Red (Yellow)	Temperature Sensor *	RED SHIELDED
E*	Black (Violet)	Temp. Sensor Source *	CABLE
F*	Gray	Aux. 1 Trip Input *	GRAY SHIELDED
G	Shielded Cable Clear	RPM Sensor	CABLE
H	Black	RPM Sensor Return	
I	Red	Supply Power Positive	
J	Cable Shield & Black	Common Negative	

* *Different from Level 6 Connections*

Figure 9 - **MAIN CONNECTOR PINS** ***(Back View)***



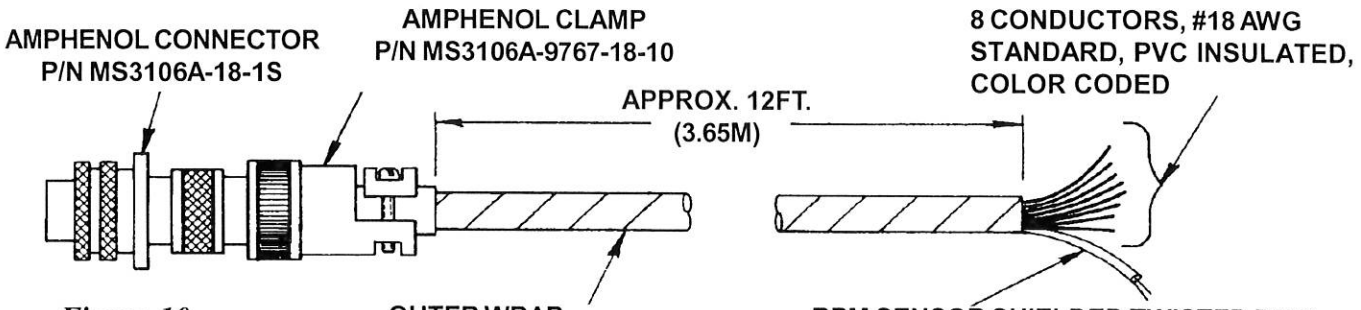


Figure 10 - **MAIN HARNESS VISUAL PARTS**

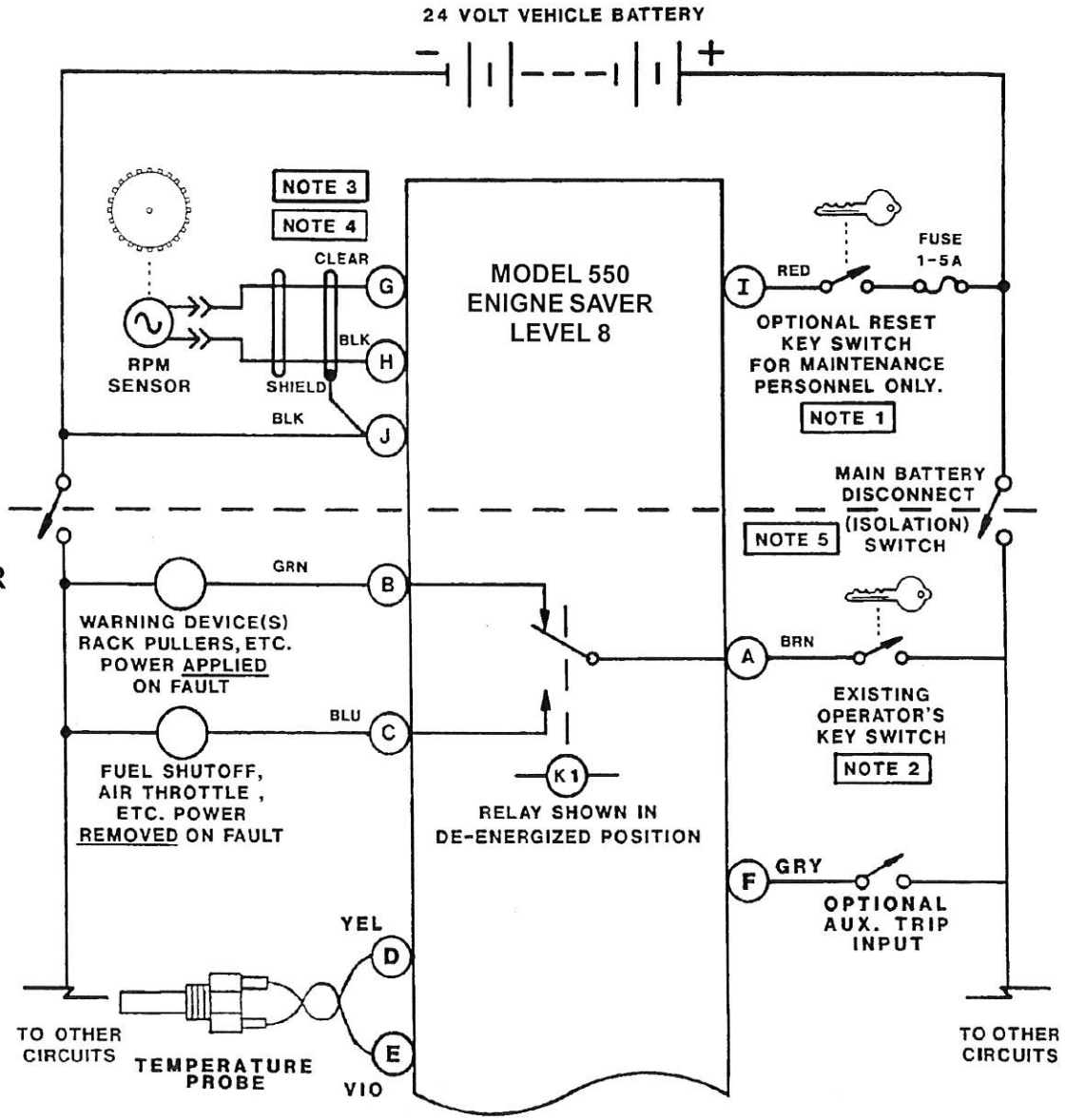


Figure 11 - **TYPICAL WIRING DIAGRAM - MAIN CONNECTOR**

NOTE 1 - To Preserve "TELL-Tale" Indicators, Power Must NOT be Interrupted to the Engine Saver Terminal "I" except by maintenance personnel. *(Units with Auxiliary Board installed have an internal 1-Amp Control Fuse).*

NOTE 2 - Alarm may be turned off with operators key switch without resetting unit.

NOTE 3 - For Alternator RPM pickup: See separate wiring diagram *(Fig. 8, Pg. 5)*.

NOTE 4 - DO NOT connect shield at RPM sensor end of cable.

NOTE 5 - Main Disconnect may be Positive, Negative or both.

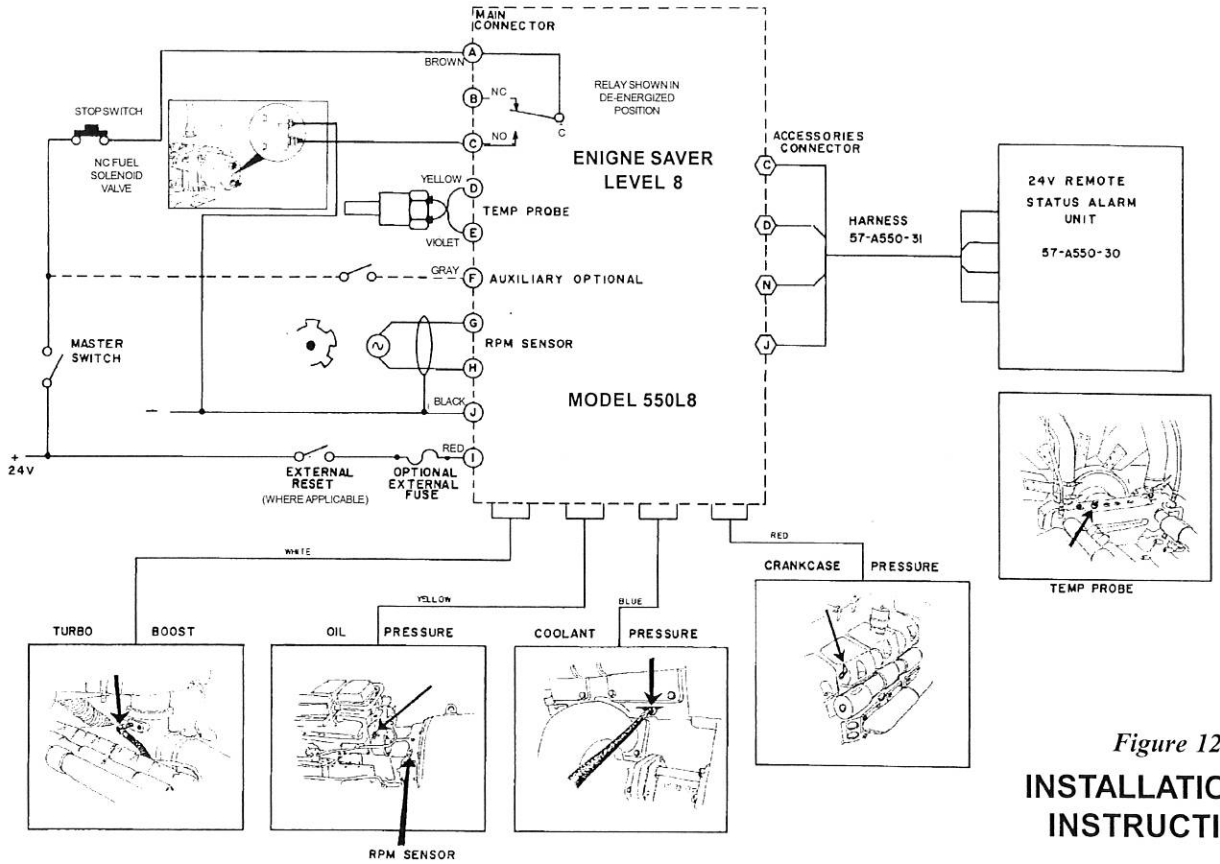
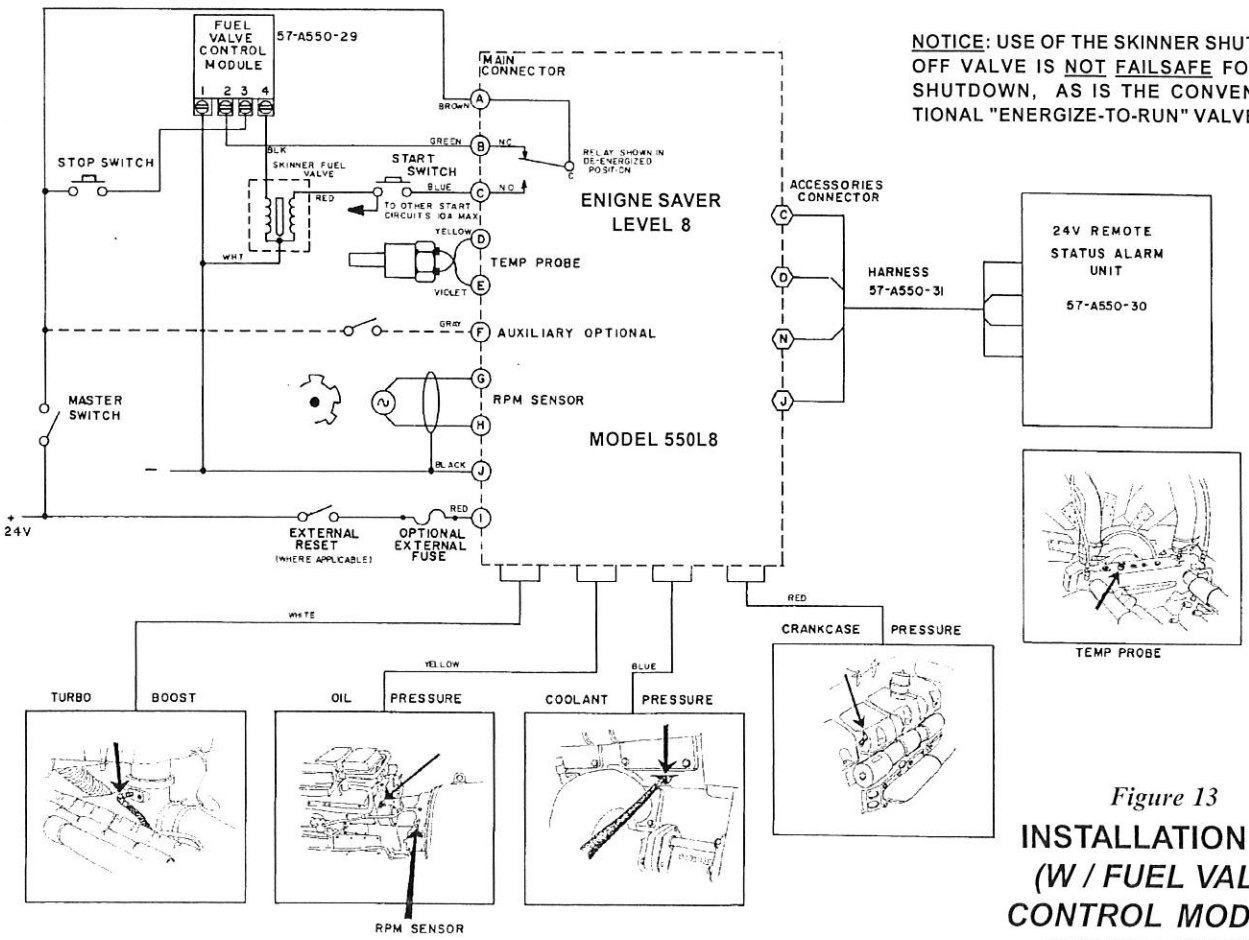


Figure 12

INSTALLATION KIT INSTRUCTIONS



NOTICE: USE OF THE SKINNER SHUT-OFF VALVE IS NOT FAILSAFE FOR SHUTDOWN, AS IS THE CONVENTIONAL "ENERGIZE-TO-RUN" VALVE.

Figure 13

INSTALLATION KIT *(W / FUEL VALVE CONTROL MODULE)* INSTRUCTIONS

• WIRING COMPATIBILITY WITH PREVIOUS LEVELS

1. COMPATIBILITY: The Level 8 Engine Saver has been designed to have a maximum amount of compatibility with previous levels (2 thru 7) with regard to the MAIN connector wiring.

2. LEVEL 2 & 6: If Level 8 Engine Saver is replacing an existing unit (Level 2 thru 7) already installed in a vehicle, it is NOT necessary to completely re-wire the MAIN Harness. Only Pins D, E and F have been re-assigned; these were used for the second set of output relay contacts.

3. PREVIOUS LEVELS: On many installations, these contacts were not required and were left unwired.

A. If Pins D, E and F were not used previously, connect them as applicable for your installation.

B. If these pins are now being used, the external devices connected to them must be re-connected to the output relay circuit on pins A, B and C of the MAIN connector.

• ACCESSORY CONNECTOR WIRING

GENERAL: Please refer to Table 2 showing pin assignment, wire color and function. With the Auxiliary Board fitted a 1-Amp ACCESSORY Fuse has been added.

1. HARNESS: A pre-wired Accessory Harness is available as an option under P/N 57-5500-52 and in a length of 15 feet. *(Custom Harnesses available upon request).*

2. NOT USED: If this connector is not used, it should remain tightly capped.

3. EVENT OUTPUTS: EVENT outputs are available for operating remote indicators and/or a remote alarm device. These include:

1. **SYSTEM ENABLE**
2. **OVERSPEED**
3. **HIGH CRANKCASE PRESSURE**
4. **LOW COOLANT PRESSURE**
5. **LOW OIL PRESSURE**
6. **HIGH TEMPERATURE**
7. **AUXILIARY FAULT 1**
8. **ALARM**
9. **AUX FAULT 2**

Table 2

ACCESSORY CONNECTOR WIRING

MS PIN	WIRE COLOR	FUNCTION
A	Wht/Brn	Overspeed Event Output
B	Yello	Aux 2 Event
C	Blk & Wht/Blk	Supply Return
D	Red	24 VDC Supply Positive (to Accessory)
E	Wht/Red	Low Oil Pressure Event Output
F	Wht/Org	Auxiliary Fault 1 Event Output
G	Wht/Yel	Hi Temperature Event Output
H	Wht/Grn	Coolant Pressure Analog Output
J	Wht/Blue	Alarm Output
K	Wht/Vio	Oil Pressure Analog Output
L	Wht/Gray	Temperature Analog Output
M	Wht/Blk/Brn	RPM Analog Output
N	Wht/Blk/Red	System Enable Event Output
P	Wht/Blk/Org	Hi Crankcase Pressure Event Output
R	Wht/Blk/Yel	Lo Coolant Pressure Event Output
S	Wht/Blk/Grn	Crankcase Analog Output
T	Wht/Blk/Blue	Turbo Analog Output

Figure 14 -
ACCESSORY CONNECTOR PINS

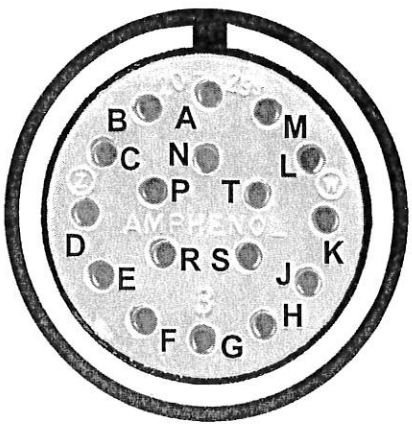
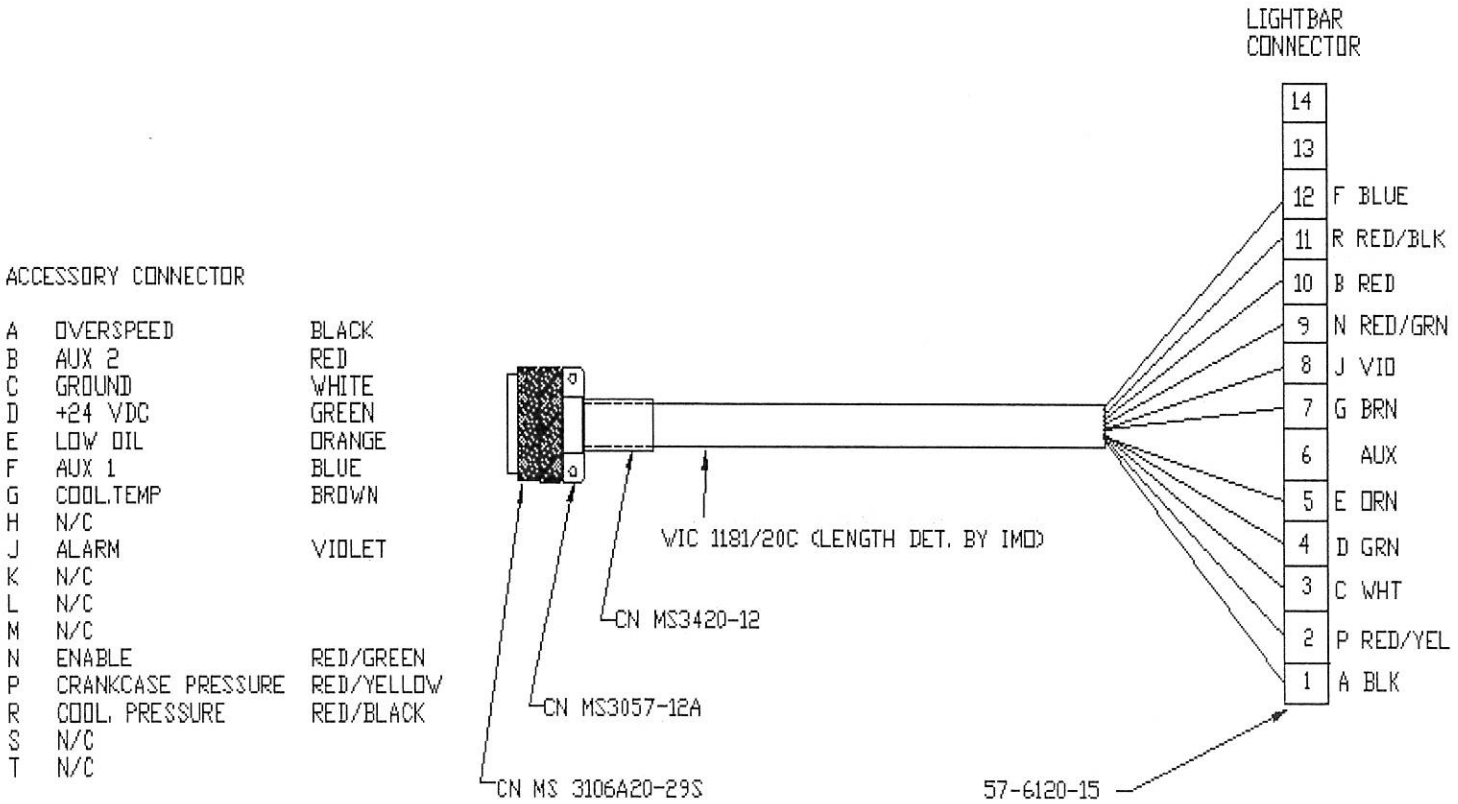


Figure 15

TYPICAL WIRING OF OPTIONAL LIGHT BAR (P/N 57-A550-59)



Pre-Wired Harness (P/N 57-A550-53, Supplied w/Light Bar) Includes all parts

• AUXILIARY CONNECTOR WIRING

GENERAL: Table 2 *(Pg. 10)* shows pin assignment, wire color and function.

1. HARNESS: A pre-wired Auxiliary Harness is available as an option under P/N 57-5500-52, and in a length of 15 feet. (Custom Harnesses available upon request).

2. NOT USED: If this connector is not used, it should remain tightly capped.

3. INPUT: Auxiliary Fault 2 Input is Pin "A" (Org), and is activated by a switch closure to system negative.

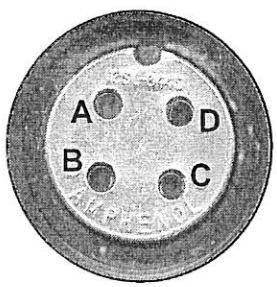
Table 3

AUXILIARY CONNECTOR WIRING

MS PIN	WIRE COLOR	FUNCTION
A	Org	Aux. Fault 2 input
B	N.C.	Spare
C	N.C.	Spare
D	Black	System Negative

Figure 16

AUXILIARY CONNECTOR PINS



TESTING AND ADJUSTMENT

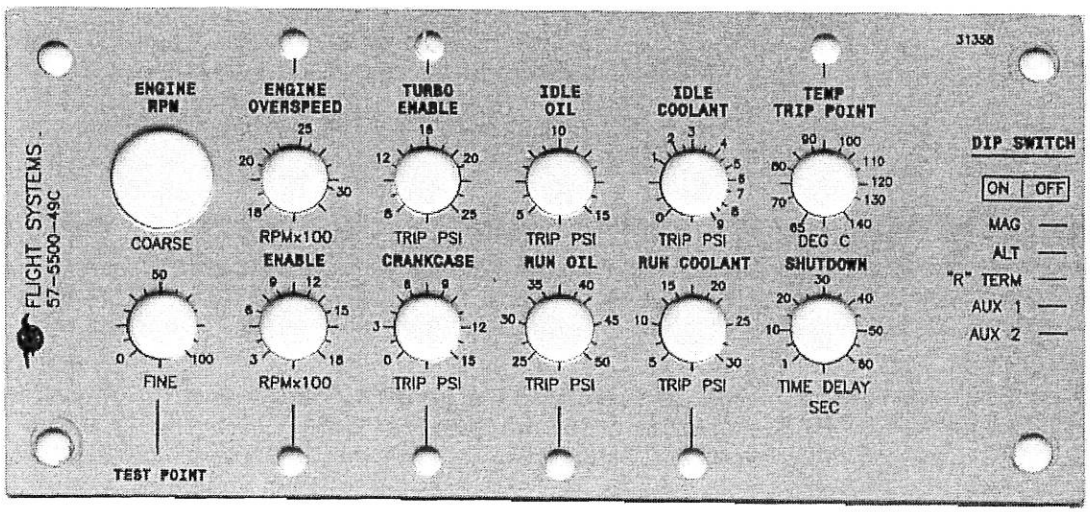
• EQUIPMENT REQUIRED

1. General: The Engine Saver can be conveniently tested with Model 9550 Engine Saver Test Set.

2. MODEL 9550: The Model 9550 provides a more complete test, with simultaneous simulation of six engine parameters, digital RPM readout and indicators for all functions. The Model 9550 is intended primarily for off-vehicle testing and pre-installation adjustment.

Figure 17

ELECTRONIC MODULE FACEPLATE
P/N57-5500-49C (Enlarged for Detail)



• RPM CALIBRATION

GENERAL: In order to sense engine RPM, an RPM pickup of some type must be fitted; See RPM Selection and Calibration. *(Table 4, Pg. 13)*

1. PROCEDURE: The RPM calibration procedure on the vehicle or engine is as follows:
A. Determine the source of RPM signal.
B. Set S1, S2, and S3 Dipswitches according to Table 4 on Pg. 13. *(Also see Fig. 17, Above & Fig. 18, Pg. 13)*
C. Hold engine at 1250 RPM *(or other point from the curve on Graph 1, Pg. 14)*
D. Adjust COARSE and FINE RPM dials for 4.00 VDC at 1250 RPM at the RPM "TEST POINT". (Electronic Module Faceplate, Fig. 17, Above)

2. COARSE AND FINE DIALS: Table 4 gives approximate "ball park" number values for the settings of the COARSE and FINE dials, however for an accurate setting, the voltage at the RPM TEST POINT must be set to 8.00 VDC at 2500 RPM or 4.00 VDC at 1250 RPM. If it is more convenient, other points on the calibration curve may be used. *(Refer to Graph 1, Pg. 14 "CALIBRATED RPM OUTPUT VOLTS vs. ENGINE RPM")*

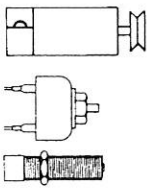
3. RPM (MONITORED OR SIMULATED): The actual RPM must be monitored (or simulated with the Model 9550 Test Set) during the calibration procedure. This can be done on the vehicle by means of the tachometer in the cab, or by an electronic strobe tachometer.

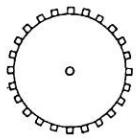
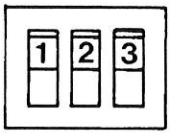
4. RPM TEST POINT: If the voltage at the RPM "TEST POINT" (Fig. 17, Pg. 12 & Fig. 22, Pg. 23) is too Low and cannot be brought into range with the RPM FINE dial, then select a higher number on the RPM COARSE dial. Conversely, if the voltage at the RPM TEST POINT is too high, select a Lower number on the RPM COARSE dial. If still having difficulty, recheck the settings of S1, S2 and S3 to be sure they are correct for the type of pickup being used. Finally, re-check the source of the RPM signal.

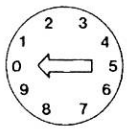
5. NOT USED: IF RPM SENSING IS NOT USED, SET PROGRAMMING SWITCH S3 TO THE "UP" (ON) POSITION. Notice when RPM Sensing is not used, the engine is only protected when the Turbo Boost is above 8 PSI (if a Pressure Switch is installed), or above the TURBO ENABLE setting (if fitted with the Auxiliary Board).

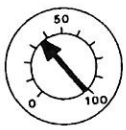
Table 4

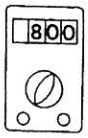
RPM SOURCE SELECTION, PROGRAMMING SWITCHES AND CALIBRATION CHART









**See note below*

Type of Pickup	Rpm Source (Take-Off Point Of Engine)	Equivalent No. of Teeth	Programming Switch			RPM Calibration (Approx. Setting)		RPM Test Point Voltage
			S1	S2	S3	Coarse	Fine	
Variable Reluctance Magnetic	Flywheel Ring Gear	168	ON	OFF	OFF	0	0	RPM TP 4.0 Volts at 1250 RPM
		142					10	
		118					20	
		103					25	
	Cam Gear (2 Cycle)	68					50	
GE Tach Gen	Crankshaft on GE Electric Drive Equipped Vehicles (Feeds LD Cont CD	50				1	30	
Mini-Gen	Crankshaft on 2 or 4 Cycle: Cam on 2-Cycle	30				2	22	
							25-45	
Other Tach Generators	On Crankshaft E.T. = Pulses /Rev. on Camshaft on 4-Cycle E.T.= Pulses/Rev 2	20-28				3	40	
		18						
		12-15				4	40-50	
		10					55	
		8				5	60	
		6				7	60	
		4				3-9	60	
Alternators	E.T.= Poles X Pulley Ratio to Crankshaft	20-28	OFF	ON	ON	2	25-45	
		18				3	40	
		12-15				4	40-50	

* SWITCH POSITIONS 4 & 5 - VERY IMPORTANT

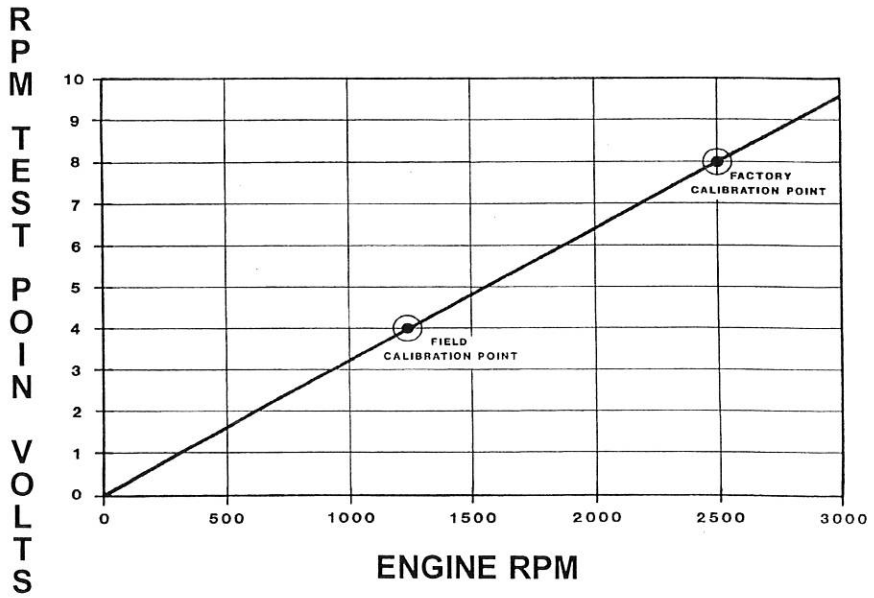
Both ON: Engine Saver will alarm even if not enabled (For low Idle applications)

Both OFF: Engine Saver will only alarm if enabled. (Standard Setting)

Graph 1

CALIBRATED RPM OUTPUT VOLTS vs. ENGINE RPM

(All Speed Ranges)



• RPM ENABLE ADJUSTMENT

GENERAL: After the RPM is calibrated, the ENABLE RPM may be set. *(Figure 17, Pg. 12)*

1. DIAL RANGE: The dial covers the range of 500 to 1800 RPM; A typical setting might be 500 -1300 RPM or higher.

2. IDLE PROTECTION: If idle protection is desired, and the normal idle RPM is 600-650, an enable RPM of 500-550 should be used.

NOTE: All Coolant and Oil Pressure monitoring ceases below the enable RPM, regardless of the pressure setting. The dial markings are a good guide, but for exact RPM settings, test equipment should be used.

3. RPM ABOVE ENABLE: When engine RPM is above the enable RPM;

A. The green indicator light on the Component side of the electronic module will light immediately.

B. Oil and Coolant Pressure monitoring begins after "SYSTEM ENABLED" indicator on the front panel of the unit is turned on (and Remote indicator, if used). Refer to page 19 for information on RPM ENABLE DELAY by temperature.

• OVERSPEED ADJUSTMENT

1. GENERAL: Use the dial markings as a guide. Use test equipment for exact settings.

2. DIAL RANGE: The OVERSPEED dial covers the range of 1800 to 3000 RPM. A Typical setting might be 2500 RPM or higher.

3. RPM ABOVE OVERSPEED: When Engine RPM is ABOVE the OVERSPEED RPM setting, the Red indicator on the component side of the electronic module will light immediately.

A. After a 0.5 (One-Half) second delay, the red OVERSPEED indicator on the front panel of the unit turns on (and Remote indicator, if used).

B. The Relay is de-energized when Overspeed indicator comes on.

C. The front panel indicator (and Remote) remains on and the Relay remains de-energized until the unit is reset.

4. NOT USED: If Overspeed protection is not desired, turn the Overspeed dial fully clockwise.

• TURBO ENABLE

GENERAL: The Engine Saver can be equipped with a Turbo Pressure Switch that is factory set at 8PSI (Non-Adjustable), or by an Analog Pressure Sensor, if fitted with the Auxiliary Board .

A. If fitted with a Pressure Switch the Turbo Enable adjustment will have NO effect..

B. With the Auxiliary Board fitted Turbo Enable can be adjusted from 8 to 25 PSI.

1. TURBOCHARGER PRESSURE AS A BACKUP: In most applications, Turbocharger Pressure is a dependable backup or auxiliary means of enabling the OIL and Coolant Pressure functions of the Engine Saver.

2. OPTIONAL: The decision to use Turbo Pressure enable is entirely optional and should be deferred to the installer. If it is not used, the Pressure Port should be plugged and the Turbo Enable Adjustment turned Fully Clockwise, (If equipped).

3. OVERRIDING RPM ENABLE: Although the Turbo Pressure can override the RPM enable at any time, it is rather unlikely, unless the RPM input had failed to produce a sufficient signal (An open in the RPM circuit will produce an Alarm).

4. EXCEEDED PRESET LEVEL: The only other conditions under which the Turbo Pressure would take precedence over RPM is if the Turbo Pressure exceeds the preset level, at any RPM below the enable RPM setting. The enable RPM would have to be set near the top of its range for this to be possible. Using such a high setting for the enable point would sacrifice Idle protection.

5. NO RPM SENSING: When no RPM sensing is used, it is necessary to:

A. Set the programming Switch S3 to the ON position to defeat the RPM fail-safe feature. *(See Figure 17, Pg. 12 and Table 4, Pg. 13)*

B. The Oil and Coolant Pressure run dials should be set to full clockwise. The Run Pressure dial settings will not apply. This is <u>not</u> recommended.

6. OPERATION: When Turbo Pressure is ABOVE the preset level:

A. Green diagnostic indicator on the component side of the electronic module lights immediately.
B. After a 10 second delay, Turbo Pressure functions the same as for RPM enable.
C. Whichever signal (RPM or Turbo) arrives first enables the system.
D. If the Turbo Pressure drops slightly below the enable pressure, the system will be disabled with no delay, unless still enabled by RPM.

• OIL PRESSURE ADJUSTMENT

GENERAL: There are TWO dials for Oil Pressure marked "IDLE TRIP" and "RUN TRIP".

1. IDLE TRIP: Dial determines the trip point below 1800 RPM, and at Idle speed, typically below 900 RPM. This point is at the intersection of the sloped and flat parts of the curve. See graph 2. The Trip point is automatically modulated by RPM between the flat parts of the curve.

2. RUN TRIP: Dial determines the trip point above 1800 RPM.

3. CHOOSING TRIP POINT: The trip point should be chosen so that under normal operating conditions, the pressure from the engine at any RPM will exceed this value by a safe margin.

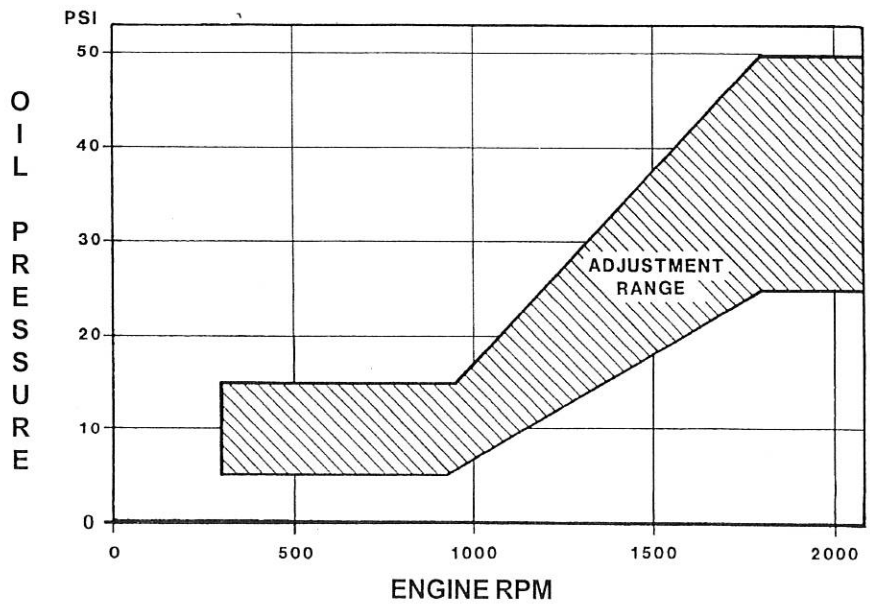
4. OPERATION: While enabled, if Oil Pressure drops below the trip point the following occurs:
A. The red diagnostic indicator on the component side of the electronic module lights immediately.
B. After an 8-10 second delay the alarm is activated and the Red LOW OIL PRESSURE indicator on the front panel (and remote indicator) is turned on.
C. After the SHUTDOWN DELAY, the Relay is de-energized until the unit is reset.

5. NOT USED: If RPM sensing is NOT used, set the IDLE OIL dial Fully Clockwise (15 PSI). The RUN OIL dial will have NO effort.

6. RUN OIL PRESSURE READING FROM DIAL: An approximate Oil Pressure reading from the engine may be read directly from the "RUN" OIL Pressure dial when the engine is at 1800 RPM or above. This is accomplished by turning the dial CLOCKWISE until OIL PRESSURE indicator lights, then read the pressure from the dial. For a more accurate reading, use a part number 57-A550-40 or 57-A550-41 Digital Annunciator.

Graph 2

OIL PRESSURE TRIP POINT vs. ENGINE RPM



• COOLANT PRESSURE ADJUSTMENT

GENERAL: There are TWO dials for Coolant Pressure marked "IDLE TRIP" and "RUN TRIP":

1. IDLE TRIP: Dial determines the trip point below 1800 RPM, and at Idle speed, typically below 900 RPM. This point is at the intersection of the sloped and flat parts of the curve. *(See Graph 3 & 4, Below)* The Trip point is automatically modulated by RPM between the flat parts of the curve.

2. RUN TRIP: Dial determines the trip point above 1800 RPM. This trip point should be chosen so that under normal operating conditions, the pressure from the engine at any RPM will exceed this value by a safe margin.

NOTE A: *We recommend choosing the **RUN COOLANT PRESSURE TRIP** point always above the Radiator Cap Pressure to assure an optimum coolant engine protection level.*

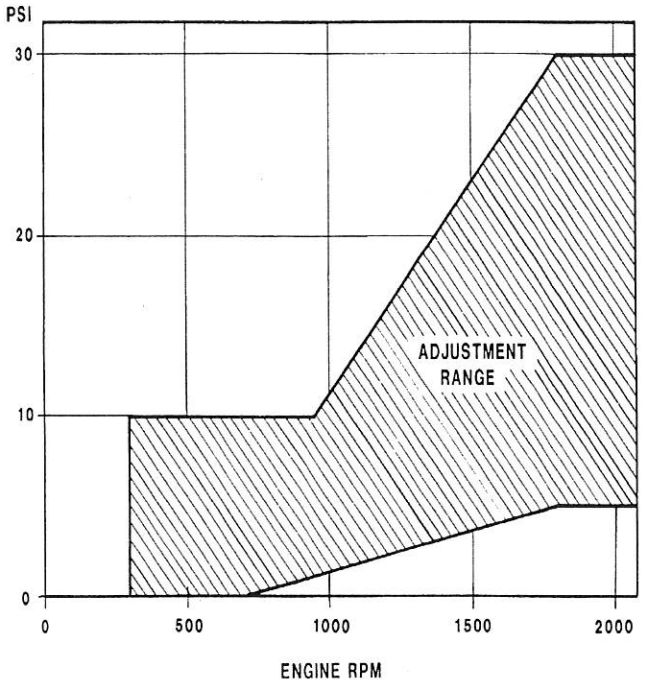
NOTE B: *In **NO CASE** should the pressure setting of the **RUN COOLANT** dial be Below the setting of the **IDLE COOLANT** dial, as this results in undesirable interaction between the dials.*

3. NOT USED: If RPM sensing is NOT used, set IDLE COOLANT dial and RUN COOLANT dial fully clockwise.

4. RUN COOLANT PRESSURE READING FROM DIAL: An approximate Coolant Pressure reading from the engine may be read directly from the "RUN" Coolant Pressure dial when the engine is at 1800 RPM or above. This is accomplished by turning the dial CLOCKWISE until the Coolant Pressure indicator lights, then read pressure from the dial. Use of the 57-A550-40 or 57-A550-41 Digital Annunciator will yield more accurate results.

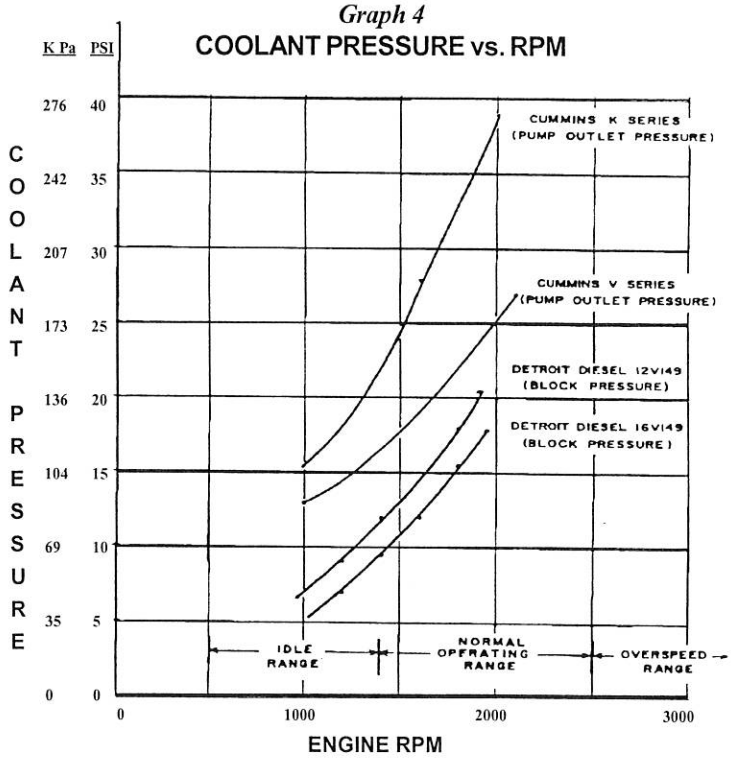
Graph 3

COOLANT PRESSURE TRIP POINT vs. RPM



Graph 4

COOLANT PRESSURE vs. RPM



• CRANKCASE PRESSURE

GENERAL: The Engine Saver can be equipped with a Crankcase Pressure Switch that is factory set at 10 inches water (Non-Adjustable), or by an Analog Pressure Sensor, if fitted with the Auxiliary Board.

A. If fitted with a Pressure Switch the Crankcase adjustment will have NO effect..

B. With the Auxiliary Board fitted Crankcase Pressure can be adjusted from 0 to 15 inches of water.

• SHUTDOWN TIME DELAY

The Shutdown Time Delay starts as soon as the alarm is activated and runs for a period of 1 to 60 seconds, adjustable. *(Figure 17 / Pg. 12)* At the end of this time, the Output relay is de-energized. In marine applications, shutdown only applies to OVERSPEED. The time delay dial controls the operation of the alarm outputs.

BENCH TEST WITH 9550 TEST SET

• CRANKCASE PRESSURE TEST (OPTIONAL)

GENERAL: The Green "SYSTEM ENABLE" light should be off for this test. Decrease RPM or Turbo-Boost Pressure using the 9550 Test Set with unit disconnected from the engine. (If your 9550 was purchased w/an earlier - Level 7 or lower - Engine Saver, it will need updated. Please contact FS Customer Service for details.)

1. **SLOWLY** increase the Crankcase Pressure from its initial value.

   A. At a Crankcase Pressure of 10 inches water Normal, +/- 1.5 inches *(if fitted with a switch)*.

   NOTE: ***If this tolerance cannot be met, the pressure switch must be replaced, as it is non-adjustable (if equipped).***

   If fitted with the Auxiliary Board, and Analog Sensor has replaced the switch, and the unit will trip at the Crankcase Pressure Adjustment setting.

   B. The Red CRANKCASE PRESSURE diagnostic indicator on the electronic module should turn-on.

2. Repeat several times, reducing the pressure to zero each time.

   A. The red "HIGH CRANKCASE PRESSURE" light on the front of the unit (and remote light) should turn on approximately 10 seconds after diagnostic indicator turns on.

   B. Relay will de-energize after the shutdown time delay.

3. Return the Crankcase Pressure to zero and verify that only diagnostic LED turns-off.

4. Momentarily press the reset button. The relay should energize as the button is released. No other lights should be on.

• TEMPERATURE CHANNEL TEST

TEMP. SENSOR: ***The Temperature Sensors used on the earlier ENGINE SAVER, Levels 2 thru 7, used P/N 57-5500-65, and ENGINE SAVERS with the S/N 07C and 08C use P/N 57-CU66-76 or 57-5500-78 --- The TEMPERATURE SENSORS used on earlier ENGINE SAVERS are NOT INTERCHANGEABLE with S/N 07C or 08C units.***

1. Rotate the Simulated Temperature dial on the 9550 Test Set slowly clockwise until the Red TEMPERATURE indicator on the electronic module just turns-on.

NOTE: ***At this point, the setting of the temperature dial on the electronic module should agree closely with the setting of the simulated temperature.***

2. Set the Engine Saver dial to the desired temperature and verify.

   A. The Red "HIGH TEMPERATURE" light on the front of the unit (and Remote Light) should Turn-On approximately 20 seconds after diagnostic LED turns on.

   B. The Alarm should activate and the Relay should de-energize after the Shutdown Time Delay.

NOTE: ***Specific Temperatures may be simulated by connecting a resistor of appropriate value in place of the TEMPERATURE SENSOR; Table 6 (at Right) may be used for this purpose.***

Table 6

PROBE RESISTANCE VS. TEMPERATURE

DEG. C.	DEG. F.	OHMS	DEG. C.	DEG. F.	OHMS	DEG. C.	DEG. F	OHMS
60.0	140.0	7599.0	90.0	194.0	2799.0	120.0	248.0	1176.0
61.0	141.8	7332.0	91.0	195.8	2714.0	121.0	249.8	1145.0
62.0	143.6	7076.0	92.0	197.6	2632.0	122.0	251.6	1114.0
63.0	145.4	6830.0	93.0	199.4	2552.0	123.0	253.4	1085.0
64.0	147.2	6594.0	94.0	201.2	2476.0	124.0	255.2	1057.0
65.0	149.0	6367.0	95.0	203.0	2402.0	125.0	257.0	1029.0
66.0	150.8	6149.0	96.0	204.8	2331.0	126.0	258.8	1002.0
67.0	152.6	5940.0	97.0	206.6	2262.0	127.0	260.6	976.3
68.0	154.4	5738.0	98.0	208.4	2195.0	128.0	262.4	951.1
69.0	156.2	5545.0	99.0	210.2	2131.0	129.0	264.2	926.7
70.0	158.0	5359.0	100.0	212.0	2069.0	130.0	266.0	903.0
71.0	159.8	5180.0	101.0	213.8	2009.0			
72.0	161.6	5007.0	102.0	215.6	1950.0			
73.0	163.4	4842.0	103.0	217.4	1894.0			
74.0	165.2	4682.0	104.0	219.2	1840.0			
75.0	167.0	4529.0	105.0	221.0	1788.0			
76.0	168.8	4381.0	106.0	222.8	1737.0			
77.0	170.6	4239.0	107.0	224.6	1688.0			
78.0	172.4	4102.0	108.0	226.4	1640.0			
79.0	174.2	3970.0	109.0	228.2	1594.0			
80.0	176.0	3843.0	110.0	230.0	1550.0			
81.0	177.8	3720.0	111.0	231.8	1507.0			
82.0	179.6	3602.0	112.0	233.6	1465.0			
83.0	181.4	3489.0	113.0	235.4	1425.0			
84.0	183.2	3379.0	114.0	237.2	1386.0			
85.0	185.0	3273.0	115.0	239.0	1348.0			
86.0	186.8	3172.0	116.0	240.8	1311.0			
87.0	188.6	3073.0	117.0	242.6	1276.0			
88.0	190.4	2979.0	118.0	244.4	1241.0			
89.0	192.2	2887.0	119.0	246.2	1208.0			

• ENABLE LOGIC AND EXCLUSIVITY TEST

GENERAL: The Green "SYSTEM ENABLE" light should be ON for this test. Make sure the unit is Reset.

1. Decrease the Oil Pressure First and the Coolant Pressure Second to 0 PSI, and wait at least 30 seconds.
   A. Diagnostic LED's should be ON, the component side of the electronic module.
   B. The Alarm should not be activated.
   C. NO lights on the front of the unit should turn on.
   D. Approximately 8 seconds later, LOW OIL PRESSURE light on the front of the unit will turn on.
2. Wait an additional 30 seconds.
   A. No other lights on the front of the unit should turn on.
   B. This shows that of these two channels the first fault to occur is the fault that latches.

NOTE: ***The TEMPERATURE channel bypasses the exclusivity logic and CAN register a trip even if another parameter such as Oil Pressure has already tripped. However, if TEMPERATURE trips first, it will lock out ALL other faults.***

• SENSOR FAIL-SAFE TESTS

1. The Engine Saver is equipped with automatic Sensor Monitoring for RPM, Temperature (External), Oil and Coolant Pressure Sensors (Internal). An Open in any of these circuits WILL cause an Alarm and a Delayed Shutdown, thereby preventing a loss of protection due to a Failed Sensor or a Broken Wire.

A. An Open Circuit condition is indicated on the front Panel of the Unit by Flashing the Overspeed, Oil, Temp, Coolant and Crankcase lights.

B. The Fail-Safe Detector is self resetting when the circuit is restored for all circuits *("A" above).*

• ACCESSORY INPUT/OUTPUT TESTS

GENERAL: Accessory Outputs are available on the 17-Pin MS Connector marked "ACCESSORY" *(See Table 2. Pg. 10)*

1. When using Model 9550 Test Set, and the above procedures for testing and adjusting the various parameters, the Remote Event outputs for SYSTEM ENABLE, LOW OIL PRESSURE, LOW COOLANT PRESSURE, TURBO PRESSURE, and CRANKCASE PRESSURE HIGH TEMP., OVERSPEED, AUXILIARY FAULT & ALARM are automatically tested via remote indicators on the Test Set. Additionally, the presence of accessory power on Pin D of the ACCESSORY connector is verified.

2. The analog outputs for RPM, OIL PRESSURE, COOLANT PRESSURE, TURBO PRESSURE, CRANKCASE PRESSURE, and TEMPERATURE are tested by connecting a digital voltmeter to the respective ANALOG OUTPUT TEST POINTS. The Meter Negative lead should be connected to the ANALOG RETURN test point. An analog voltage from 0 to 5 VDC will be measured that is proportional to the value of the parameter that it represents, as follows:

A. RPM Analog Signal 0-3000 RPM = 0-5.0 VDC
B. OIL PRESSURE Analog Signal 0-72 PSI = 0-5.0 VDC
C. COOLANT PRESSURE Analog Signal 0-30 PSI = 0-5.0 VDC
D. TEMPERATURE Analog Signal 65°-140° F. (68°-60° C.) *(See Table 6, Pg. 18)*

• RECORDING INSTALLATION DATA - *(Use Form On Page "D", in Front of Manual)*

1. GENERAL: After the installation is complete and all adjustments have been made satisfactorily, the installing agent or user is encouraged to record all installation particulars and settings.

2. VALUABLE IN FUTURE: A permanent record of this information will prove valuable to the user in the future for reference when doing additional installations, or for simply verifying settings.

3. COPY: A duplicate copy of the complete form should be forwarded to Flight Systems or its agent for Warranty support and inclusion in the master installation data file. Please take this extra step, as it will benefit YOU as well as others.

• TAMPER RESISTANT FEATURES

1. GENERAL: After the Engine Saver has been installed and properly adjusted, it maybe desirable in some installations to discourage or prevent entry into the unit by unauthorized personnel.

2. CONNECTOR & COVER SEALS: Since the unit can be Reset by momentarily disconnecting it from the vehicle, it may also be desirable to prevent removal of the harness (loom) connector. A means has been provided to attach a lead seal or similar device to both the cover and/or electrical connector.
(See Figure 19 at Right)

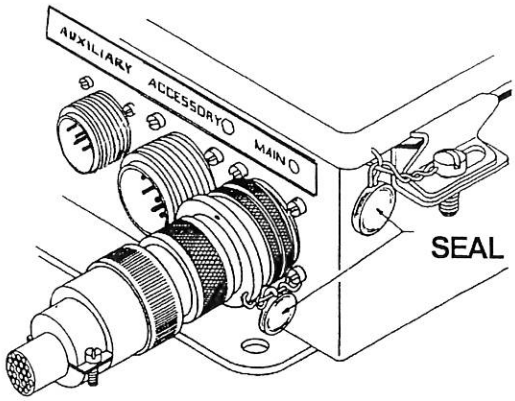


Figure 19
LEAD SEAL LOCATION

TROUBLESHOOTING INSIDE THE ENGINE SAVER

• PRESSURE SENSORS

1. GENERAL: Pressure Sensors used in the Engine Saver are Diaphragm type. The movement of the diaphragm causes a resistance to change or a switch to close.

2. PRESSURES: (See Table 7, below) These sensors will withstand much higher pressures, however, without damage.

3. CRANKCASE: The Crankcase Pressure Sensor (switch) is very delicate and may be damaged by Pressures exceeding 5 PSI. Its normal trip point is 10 inches of water ± 20%. If fitted with the Auxiliary Board the Sensor is on the Board.

4. COOLANT: The Coolant Pressure Sensor has a range of 0 to 30 PSI.

5. OIL: The Oil Pressure Sensor is very similar but has a range of 0 to 72 PSI.

6. SENSOR CHECK: Oil, coolant and turbo sensors may be easily checked in or out of the unit by applying a source of regulated air pressure and measuring the resistance with a volt-ohm-meter (VOM) such as a Simpson 260.

A. The resistance should change smoothly with changing pressure. The sensor should be "tapped" to minimize frictional effects during measurement.

B. If the resistance change "sticks" or is erratic in any way, the Sensor should be replaced. A leaking or tightly clogged sensor may not give repeatable results. Use Table 7 below as a guide.

Table 7
SENSOR RESISTANCE

SENSOR	PRESSURE	RESISTANCE (Ohms)	HOW TO MEASURE
TURBO "SEE NOTE 1"	Below 6 PSI Above 8 PSI	Infinity - 0 -	Between Terminals R X 1 Range
COOLANT "SEE NOTE 1"	0 PSI 15 PSI 30 PSI	6 - 12 80 - 100 190 - 210	Between Terminals R X 1 Range
OIL	0 PSI 25 PSI 50 PSI	6 - 12 70 - 80 130 - 140	Between Terminals R X 1 Range
CRANKCASE "SEE NOTE 2"	0 to 15 in. Water	Infinity - 0 -	Between Terminals R X 100 Range

NOTE 1: TURBO PRESSURE sensing can be done with a pressure switch, or if fitted with the Auxiliary Board, an Analog Pressure Sensor, the Coolant Sensor 0-30 PSI, is used.

NOTE 2: <u>DO NOT</u> **exceed 5 PSI.** <u>DO NOT</u> **use R X 1 for this test.**

7. TURBO: The Turbo Pressure Sensor (Switch) is normally open and closes at about 15 inches Hg. (approximately 7 PSI), if equipped.

8. REPLACING SENSORS: When replacing sensors, make sure the new unit is installed in the correct position (Turbo, Oil or Coolant) in the enclosure.

A. Tighten snugly, but do not over-tighten.

B. Teflon pipe compound should be used on the threads.

C. Make certain that the tubing on the crankcase pressure switch is not kinked or clogged, and that it is connected to the inlet marked "high" on the switch (If equipped).

D. The push-on electrical connections are not polarized, and it is immaterial if they are reversed.

9. INTERMITTENT CONNECTION: If erratic operation is encountered and the suspect sensor checks okay, the problem could be a broken or intermittent connection within the unit's Internal or External wiring harness or a pressure line problem.

10. LEDS FLASHING: An open circuit in All but Auxiliary, Crankcase and Turbo channels will cause this.

11. CLOGGED LINE: A piece of rubber or other solid material may clog a line acting like a check valve. Pressure will enter and charge the line but will not fall as the actual engine pressure does. This can result in excessively long delays in tripping or failure to trip. Make sure lines are clear. There is virtually no way to guard against this potential loss of protection other than periodic checks of the system.

12. JUMPER: Any of the four sensors may be temporarily JUMPED out (shorted) for troubleshooting purposes. A short on the oil or coolant sensors corresponds to zero pressure and will cause a fault.

14. CRANKCASE PRESSURE SWITCH: A jumper (short) corresponds to pressure above 10 inches of water and will cause a fault.

15. TURBO PRESSURE SWITCH: A short on the turbo pressure switch corresponds to pressure above 15 in. Hg. and will cause the unit to enable. **NOTE:** ***Not applicable on units with the Auxiliary Board added.***

CAUTION: WHEN REMOVING OR REPLACING WIRES ON THE PRESSURE SENSORS, DO NOT UNDER ANY CIRCUMSTANCES PRY OFF THE TERMINALS OR ALLOW TOOLS OR OTHER METAL OBJECTS TO FORM A CIRCUIT BETWEEN EITHER SENSOR TERMINAL AND THE SENSOR CASE. PERMANENT SENSOR DAMAGE MAY RESULT.

• TEMPERATURE SENSOR

GENERAL:. The Temperature Sensor used with the Engine Saver is a Thermistor device that has a Negative Temperature Coefficient. Its resistance is nominally 30,000 ohms at 25° C, and decreases with rising temperature. *(See Table 6, Pg. 18)*

1. OPEN SENSOR: Regardless of the type of temperature sensor used, an open sensor or wire will be detected and cause the TEMPERATURE indicator to flash.

2. INTERMITTENT CONNECTION: If false tripping occurs, check probe resistance against Table 6, Pg. 18; check probe wiring for continuity.

3. SHIELDING: Extreme electrical noise or long wire runs may also cause false tripping. Under these conditions probe wires should be twisted or shielded. The shield should be connected to MAIN connector Pin J (Gnd.).

4. IF SENSOR NOT USED: In an installation where temperature sensing is not used, the temperature input must be satisfied. Connect a 5.2K resistor between Pins "D", and "E" of the MAIN (10-pin) connector. This will increase the time delay for Enable, Coolant, and Oil from 75 to 90 seconds.

• RPM SENSOR

GENERAL: Failure of the Reluctance Pickup, Tachometer Generator, Alternator "R" terminal output or the interconnecting cable will result in a loss of the RPM ENABLE and OVERSPEED function of the Engine Saver, except when the engine is in Turbo Boost range.

When RPM is the only means of Enabling the Engine Saver, failure of RPM signal would result in a loss of engine protection.

1. OPEN OR INTERMITTENT: To guard against this possibility, the Fail-Safe circuit detects the open circuit, activates the Alarm immediately and de-energizes the Output Relay after the Shutdown Time Delay elapses. The OVERSPEED indicator remains flashing to show that an open circuit exists in the RPM sensor or wiring.
NOTE: THERE IS NO RPM FAIL-SAFE WHEN "R TERMINAL" IS USED.

2. RELUCTANCE PICKUPS: Part numbers listed below may be checked with the following procedure:

57-A995-01 RPM SENSOR ASSY 5/8" - 18 / 2" Length/WPC*

57-A995-03 RPM SENSOR ASSY 5/8" - 18 / 3" Length/WPC

57-A995-04 RPM SENSOR ASSY 3/4" - 16 / 3" 1/2 Length/WPC

57-A995-05 RPM SENSOR ASSY 5/8" - 18 / 1" Length/MC**

57-A995-06 RPM SENSOR ASSY 5/8" - 18 / 4" Length/WPC

57-A995-07 RPM SENSOR ASSY 3/4" - 16 / 4" Length/WPC

57-CU66-22 RPM SENSOR ASSY 3/4" - 16 / 4" Length/MC

57-CU66-75 RPM SENSOR ASSY 5/8" - 18 / 4" Length/MC

* WPC = Weather Proof Connector

** MC = Military Connector

3. RESISTANCE CHECK: Disconnect the cable from the pickup and measure its resistance with a VOM (such as a Simpson 260) set to "R x 1". The above Pickups should measure from 100 to 200 ohms. This reading can vary from 100 ohms to several thousand ohms, for other Pickups. It would be helpful to compare this reading with an identical known good Pickup, if possible. If the reading is near Zero or Infinity, the Pickup is likely defective.

4. VOLTAGE TEST: The output may be checked with a VOM at cranking speeds. If the Pickup is okay, the Gap is set properly it will produce approximately 0.5 volts AC (RMS) as measured on the lowest AC volts range of a VOM (such as a Simpson 260). If the needle barely moves when the engine is turned over, the Gap may be too wide.

5. OHMMETER TEST: If still in doubt, remove the pickup from the engine and place a steel object (at least .125 in. or 3-4 mm. in thickness) across the face of the pickup. Move the steel piece in and out and note that the VOM needle moves either side of its resistance reading. (A pair of diagonal cutters or side-cutting pliers works well for this test.) If this response cannot be obtained, the pickup is likely defective.

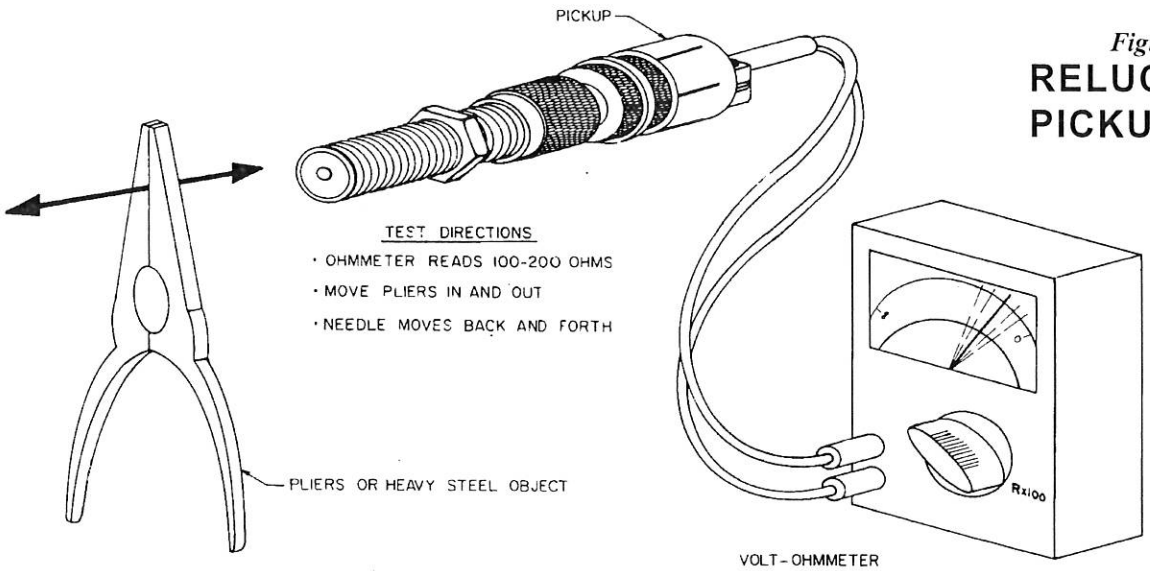


Figure 20
RELUCTANCE PICKUP TEST

6. TACHOMETER GENERATORS: The Tachometer generators 57-SGEN-FT and 57-SGEN-NF may be tested with a VOM. A resistance reading of 250-300 ohms should be obtained on the RX100 scale. Turning the shaft slowly should cause the needle to flutter. When the engine is running, an AC voltage of 1-30 volts is generated, depending on RPM.

• ELECTRONIC MODULE

1. REPLACING: This module is replaced as a unit since the necessary equipment & parts make field repair impractical.

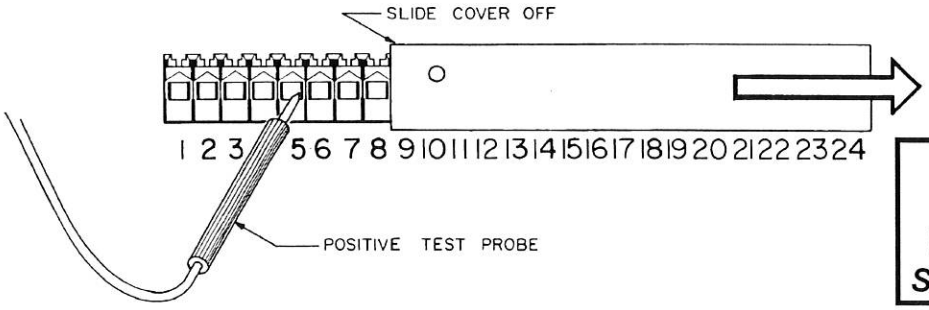
2. ENCAPSULATED: Also, the module is encapsulated in a clear jelly-like silicone compound for environmental protection, which may be difficult to replace.

3. MOUNTING: The module is held in place by means of four screws in the corners of the nameplate.

4. ELECTRICAL CONNECTIONS: Connections are made by means of a single 24-pin connector. This connector has a protective cover that slides off to expose the numbered test points. There are two additional connectors "J2" and "J3". "J2" suppliessignals to and from the Auxiliary Board, "J3" (2 pins) is for the Auxiliary Fault "2".

5. TEST VOLTAGES: Table 8 *(on Pg. 24)* gives the voltages appearing at each test point *(Figure 21, Below)* under the conditions specified. These readings are useful in isolating a faulty electronic module or a fault elsewhere in the system. A module that does not give the correct voltages, or fails to respond to correct input signals may be presumed to be defective. A defective module is repairable and should not be discarded.

Figure 21
ELECTRONIC MODULE TEST POINTS



NOTE:
ALL READINGS TAKEN WITH VOM NEG. LEAD ON SENSOR COMMON (BLACK)

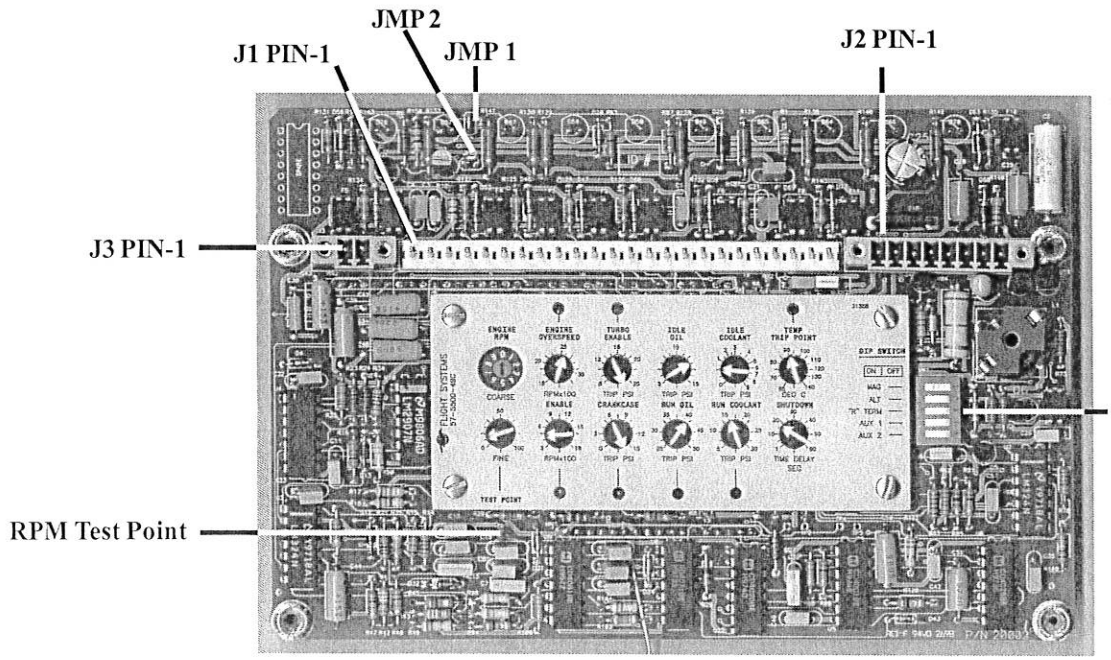
• RELAY

WITHOUT Auxiliary Board: The Relay is a standard commercially available unit with a 24 volt DC coil and DPDT Silver contacts. It may be easily checked with a VOM or test light. The coil resistance (A and B) is approximately 500 ohms. It is connected by means of a polarized eight connector plug, making replacement easy. *(Fig. 23, Pg. 25 & Fig. 28, Pg. 30)*

• INDICATORS

The Red and Green LED type indicators that appear behind the plastic lens on the front of the unit are an integral part of the electronic module and cannot be replaced as separate items. These indicators are very reliable and it is quite unlikely that any of them would ever have to be replaced in the life of the unit.

Figure 22
ELECTRONIC MODULE LAYOUT
P/N 57-5500-49C



Note: ***There is a potentiometer adjustment wand attached close to the circuit board.***

Table 8

ELECTRONIC MODULE TEST POINT VOLTAGES

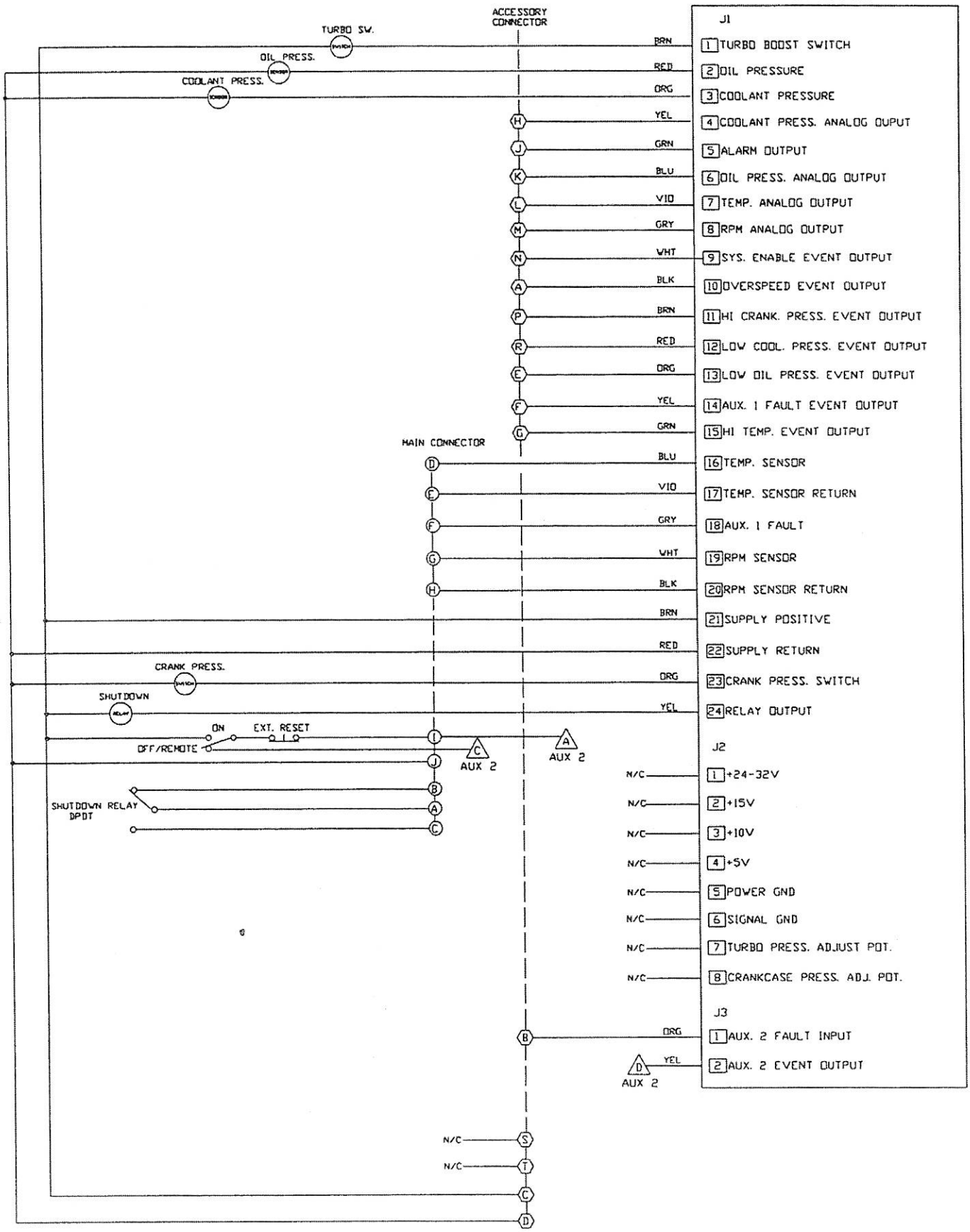
24 Pin Connector	Wire Color	Main Connector	Accessory Connector	Function	Voltages/Condition
1	Brown	--	--	Turbo Pressure Sensor	1. 0V at 5.5 PSI or below
2	Red	--	--	Oil Pressure Sensor	1. .04V at 0 PSI 2. .54V at 50 PSI 3. 6.0V with Sensor Wire Off
3	Orange	--	--	Coolant Pressure Sensor	1. .04V at 0 PSI 2. .76V at 30 PSI 3. 6.0V with Sensor Wire Off
4	Yellow	--	H	Coolant Pressure Analog Output	1. .1 at 0 PSI 2. 5.0V at 30 PSI
5	Green	--	J	Alarm Output	1. Always 0V with No Connection 2. 24V 9570 Connected - No Alarm 3. On 9570 Connected - Steady Alarm
6	Blue	--	K	Oil Pressure Analog Output	1. .25V at 0 PSI 2. 5.0V at 60 PSI
7	Violet	--	L	Temperature Output	1. 5V at 158°F Simulated 2. 2.95V at 212°F Simulated 3. 1.5V at 266°F Simulated
8	Gray	--	M	RPM Analog Output	1. 0V at 0 RPM 2. 5.0V at 3000 RPM (RPM Cal.)
9	White	--	N	System Enable Event Output	1. 15 V - Not Tripped 2. 0V - Tripped
10	Black	--	A	Overspeed Event Output	1. 15 V - Not Tripped 2. 0V - Tripped
11	Brown	--	P	Hi Crankcase Pressure Event Output	1. 15V - Not Tripped 2. 0V - Tripped
12	Red	--	R	Lo Coolant Pressure event Output	1. 15V - Not Tripped 2. 0V - Tripped
13	Orange	--	E	Lo Oil Pressure Output	1. 15V - Not Tripped 2. 0V - Tripped
14	Yellow	--	F	Auxiliary Fault Event Output	1. 15V - Not Tripped 2. 0V - Tripped
15	Green	--	G	High Temperature Event Output	1. 15V - Not Tripped 2. 0V – Tripped
16	Blue	D	--	Temperature Sensor	1. 5.1V at 158°F Simulated 2. 1.5V at 266°F Simulated
17	Violet	E	--	Temp. Sensor Return	1. 0V at ALL TIMES
18	Gray	F	--	Auxiliary Trip Input	1. 0V – No Aux. Fault 2. 24V - Aux. Fault Simulated
19	White	G	--	RPM Sensor	1. *0.3VAC-Simulated MAG. Pickup, 2. Higher with Actual Mag. Pickup 3. *7VDC-Simulated Alt. Pickup, Higher with Actual Alternator.
20	Black	H	--	RPM Sensor Return	1. 0V at ALL TIMES
21	Brown	I	D	Positive 24V Supply	1. 24V at ALL TIMES
22	Red	J	C	Common Negative	1. 0V at ALL TIMES (Negative Ref.)
23	Orange	--	--	Crankcase Pressure Switch	1. 15V - C.C. Pressure Below 8 in. W.C. 2. 0V - C.C. Pressure Below 12 in. W.C.
24	Yellow	--	--	Relay Return	1. 0V - Relay Energized 2. 24V – Relay De-Energized

- Measured with SIMPSON 260 VOM, or equal. DMM's MAY NOT give same readings.

Figure 23

ENGINE SAVER INTERNAL WIRING *WITHOUT* AUXILIARY BOARD

Engine Saver Board Rev. 49C
P/N 20002



• AUXILIARY BOARD (Optional Equipment / Sold Separately)

General: The Auxiliary Board provides Analog Turbo, and Crankcase Pressure sensing, Reset, and a Relay. There are two ways Turbo and Crankcase Pressure can be sensed: The first is with a Pressure Transducer, providing Analog Sensing of the Pressure. The second is with a fixed Pressure Switch.

1. ANALOG TURBO SENSING: When fitted with a Pressure Transducer, Analog sensing is made possible. The Transducer is connected to J6 pin 1, & 2; there is no polarity on the transducer. Also, jumper "JMP 2 pins 1 & 3" must be set.

2. TURBO PRESSURE SWITCH: The Pressure Switch is connected to "J7 pins 1 & 2". Also, jumper "JMP 2 pins 1 & 2" must be set.

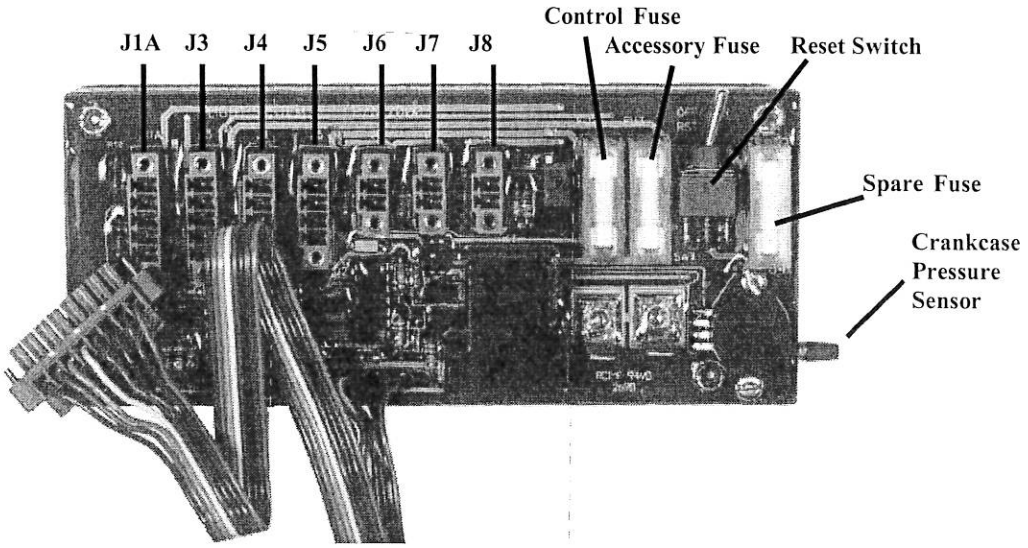
3. ANALOG CRANKCASE: The Pressure Transducer is part of this board; jumper "JMP 2 pins 1 & 3" must be set.

4. CRANKCASE PRESSURE SWITCH: The Pressure Switch is connected to "J8 pins 1 & 2". Also jumper "JMP 1 & 2" must be set.

5. RESET SWITCH: This switch is used to turn-off power, Resetting the Engine Saver, when a Fault has occurred, "Resetting the Tell-Tale Indicators" on the Front Cover of the Engine Saver. *(See Figures 24 & 25 Below)*

6. RELAY: This Relay is part of this board, and is brought out to the Main Connector. *(See above & Figs. 9, Pg. 7; 24 & 25, Below)*

Figure 24
AUXILIARY BOARD LAYOUT P/N 57-A550-93



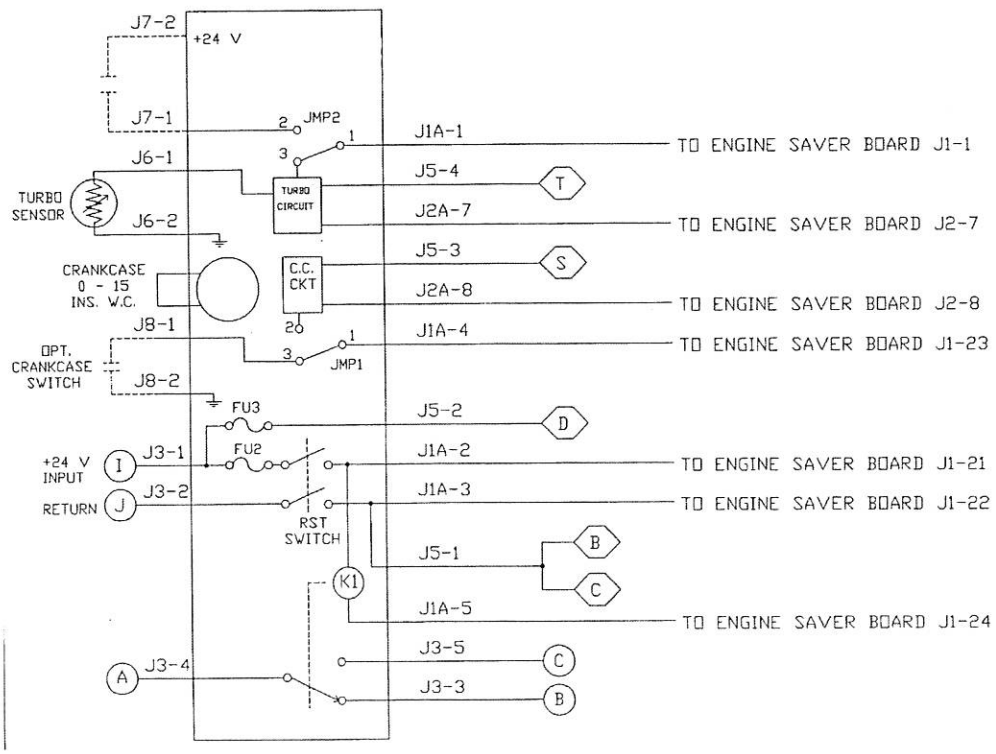


Figure 25
AUXILIARY BOARD INTERNAL BLOCK DIAGRAM

Table 9

AUXILIARY BOARD TEST POINT VOLTAGES

JIA	WIRE COLOR	E.S. BOARD J1	FUNCTION	VOLTAGE CONDITION
1	BRN	1	TURBO PRESSURE	* 0V = NOT TRIPPED +24V = TRIPPED
2	BRN	21	SUPPLY POSITIVE (RET SW)	RESET OFF = 0V ON = +24V
3	RED	22	SUPPLY RRTN	RESET OFF = OPEN ON = 0V
4	ORG	23	CRANKCASE PRESSURE	CHECK
5	YEL	24	RELAY OUTPUT	+24V = NOT TRIPPED 0V = TRIPPED

* JPM 2 SET TO PINS 2 AND 3

J2A	WIRE COLOR	E.S. BOARD J2	FUNCTION	VOLTAGE CONDITION
1	BRN	1	+ 24V UNREG	RESET OFF = 0V ON = 24V
2	RED	2	+ 15V	RESET OFF = 0V ON = +15V ± 5%
3	ORG	3	+ 10V	RESET OFF = 0V ON = +10V ± 5%
4	YEL	4	+ 5V	RESET OFF = 0V ON = +5V ± 5%
5	GRN	5	POWER	RESET OFF = 0V ON = 0V
6	BLUE	6	SIGNAL GND	RESET OFF = 0V ON = 0V
7	VIO	7	TURBO PRESSURE ADJ.	CHECK
8	GRAY	8	CRANKCASE PRESSURE ADJ POT	CHECK

J3	WIRE COLOR	Main Connect.	FUNCTION	VOLTAGE CONDITION
1	RED	I	+24V INPUT	+24V
2	BLK	J	RETURN	0V
3	GRN	B	RELAY N.C.	RELAY N.C.
4	BRN	A	RELAY COMMON	RELAY COMMON
5	BLUE	C	RELAY N.P.	RELAY N.O.

J5	WIRE COLOR	Access. Connect.	FUNCTION	VOLTAGE CONDITION
1	WHT/BLK	B	ANALOG RETURN	0V
2	JUMPER	C	SUPPLY RETURN	0V
3	RED	S	ANALOG CRANKCASE SIG OUTPUT	0V AT 0 INS. W.C. 5V AT 15 INS. W.C.
4	WHT/BLK/BLU	T	ANALOG TURBO SIG OUTPUT	0V AT 8 PSI 5V AT 2.5 PSI

J6	WIRE COLOR	SENSOR	FUNCTION	VOLTAGE CONDITION
1	WHT	-	SIGNAL	CHECK
2	BLK	-	RETURN	0V

RENEWAL PARTS LIST

ITEM NO.	DESCRIPTION	RENEWAL PART NO.
*1	ELECTRONIC MODULE	57-5500-49C
*2	TRANSDUCER, OIL PRESSURE	57-5500-12
*3	TRANSDUCER, COOLANT PRESSURE	57-5500-45
*4	SWITCH, CRANKCASE PRESSURE W/TUBING	57-5500-38
*5	SWITCH, TURBO BOOST ENABLE	57-5500-53
6	INTERNAL WIRING HARNESS W/SWITCH	57-5500-67
7	EXTERNAL MAIN WIRING HARNESS - 12'	57-5500-24
8	TEMPERATURE SENSOR	57-CU66-76
(or)	TEMPERATURE SENSOR (1/4" NPT Small Engines)	57-5500-78
*9	RELAY (24v)	57-5500-02
10	RELAY MOUNTING BRACKET	57-5500-56
11	BULKHEAD ADAPTERS (4 per unit)	57-5500-10
12	GASKET (INSIDE COVER)	57-5500-25
13	ACCESSORY CONNECTOR CAP W/CHAIN	57-5500-54
14	TEMPERATURE SENSOR HARNESS	57-ACU1-01
15^	FACEPLATE	57-5500-48C
16^	PRESSURE INLET LABEL	57-5500-50
17^	INSTALLATION/OPERATIONS MANUAL	57-A550-26

** THESE ITEMS ARE RECOMMENDED AS INVENTORY SPARES.*

^ THESE ITEMS NOT SHOWN IN ILLUSTRATIONS ON NEXT PAGE.

• SEE NEXT PAGE FOR ILLUSTRATION OF PARTS & PART LOCATIONS

Figure 27

ENGINE SAVER® MODEL 550 LEVEL 8 *WITHOUT* AUXILIARY BOARD
REPLACEMENT PARTS LOCATIONS

SORB-IT PACKS:
5 moisture-absorbent chemical packs are inside the Engine Saver to help prevent corrosion and moisture build-up. These may be removed at the user's discretion.

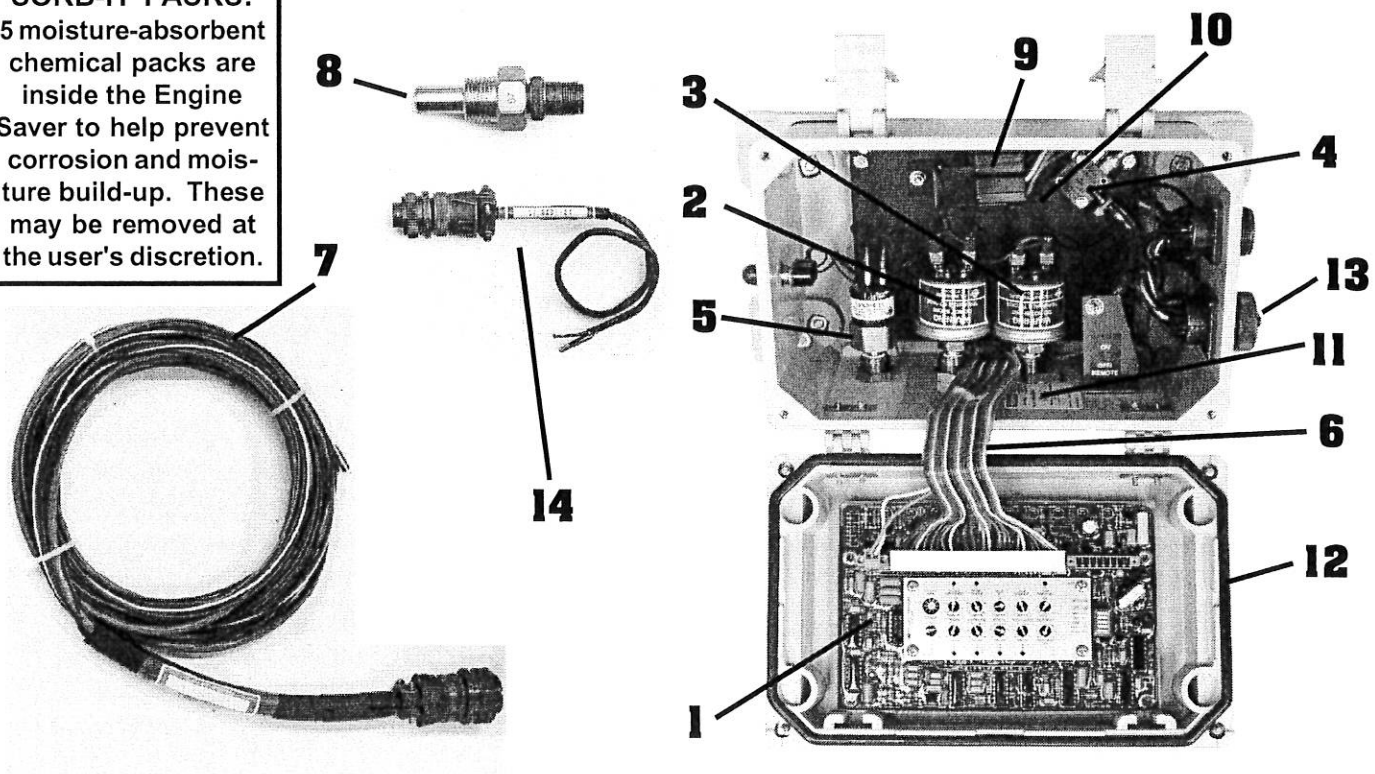


Figure 28

ENGINE SAVER® MODEL 550 LEVEL 8 *WITHOUT* AUXILIARY BOARD
INDIVIDUAL PARTS - VISUAL IDENTIFICATION

NO.	DESCRIPTION
1	ELECTRONIC MODULE
2	TRANSDUCER, OIL PRESSURE
3	TRANSDUCER, COOLANT PRESS.
4	SWITCH, CRANKCASE PRESSURE
5	SWITCH, TURBO BOOST ENABLE
6	INTERNAL WIRING HARNESS W/SWITCH
7	EXTERNAL MAIN WIRING HARNESS - 12'
8	TEMPERATURE SENSOR
9	RELAY (24V)
10	RELAY MOUNTING BRACKET
11	BULKHEAD ADAPTERS (4 / UNIT)
12	GASKET (INSIDE COVER)
13	ACCESSORY CONNECTOR CAP
14	TEMPERATURE SENSOR HARNESS

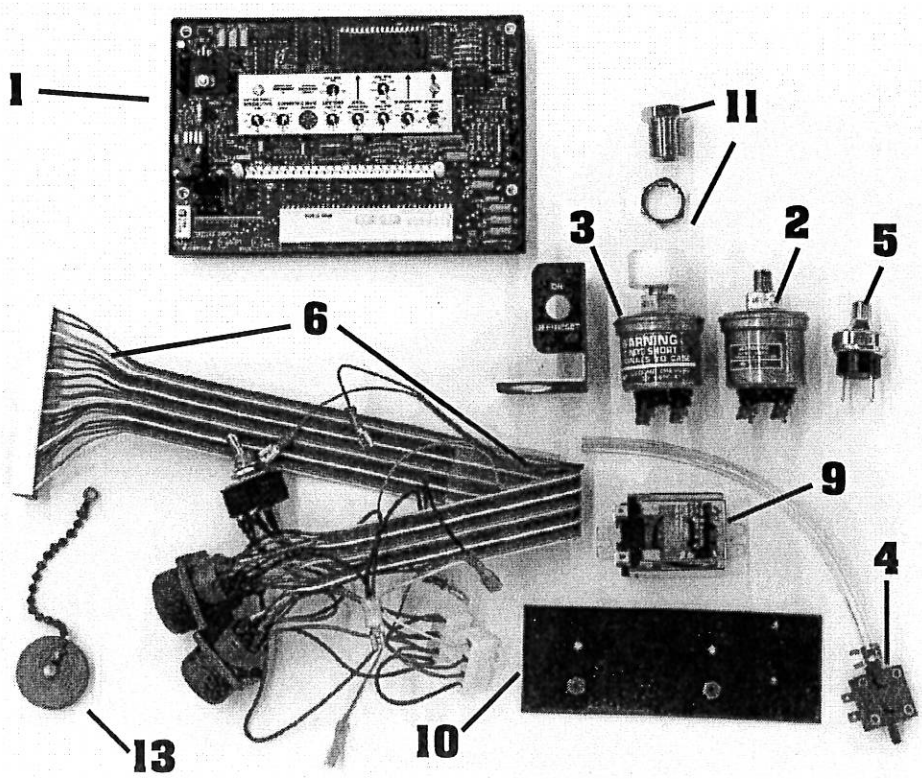
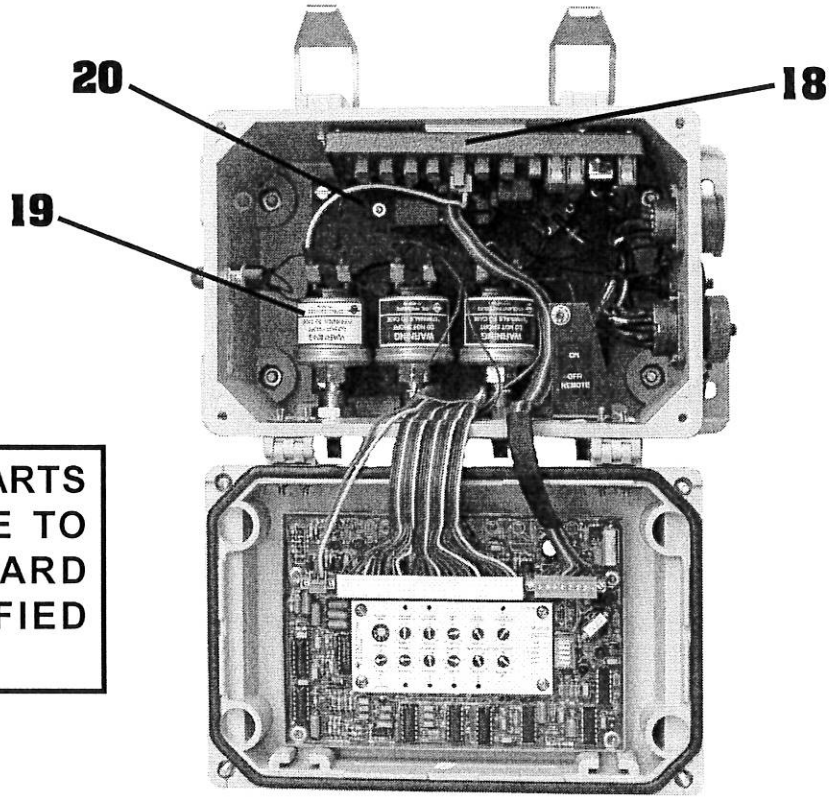


Figure 29

ENGINE SAVER® MODEL 550 LEVEL 8 *WITH* AUXILIARY BOARD
REPLACEMENT PARTS LOCATIONS

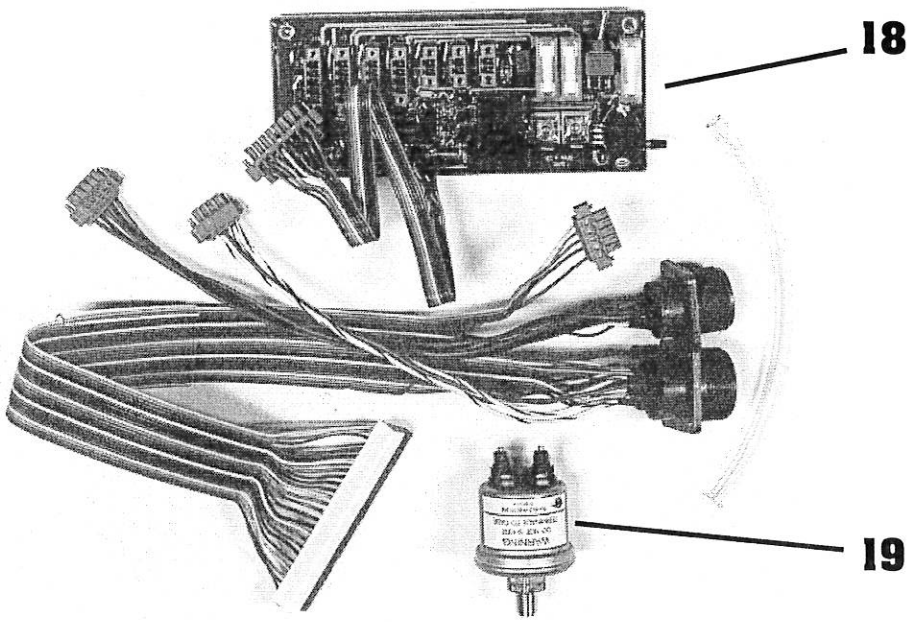
NO.	DESCRIPTION
18	AUXILIARY BOARD
19	TURBO TRANSDUCER
20	AUXILIARY BOARD BRACKET



NOTE: *ONLY* THOSE PARTS WHICH ARE EXCLUSIVE TO THE *"AUXILIARY"* BOARD VERSION ARE IDENTIFIED ON THIS PAGE.

Figure 30

ENGINE SAVER® MODEL 550 LEVEL 8 *WITH* AUXILIARY BOARD
INDIVIDUAL PARTS - VISUAL IDENTIFICATION



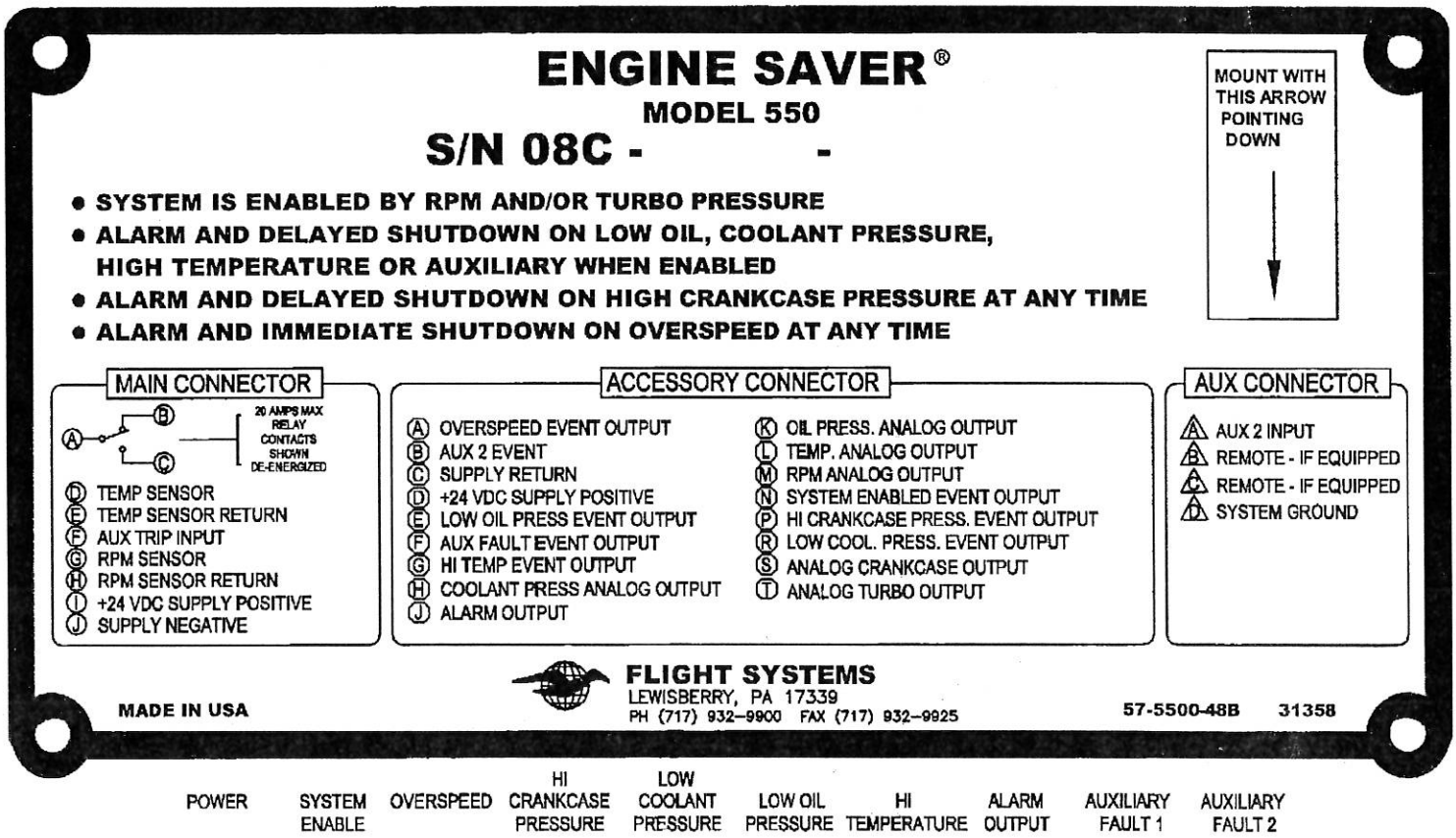


Figure 31

ENGINE SAVER® MODEL 550 FACE PLATE

OPTIONAL PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION
1	57-5500-05	CRANKCASE SW. 6"H20
2	57-5500-23	CRANKCASE SW. 8"H20
3	57-5500-33	CRANKCASE SW. 15"H20
4	57-5500-15	CRANKCASE SW. 40"H20
5	57-5500-14	MATING PLUG KIT
6	57-5500-52	ACCESSORY HARNESS 15' Length
7	57-5500-66	ACCESSORY HARNESS Length
8	57-5500-55	TEMP. SENSOR 3/8" NPT
9	57-5500-59	TEMP. SENSOR 1/2"NPT
10	57-5500-57	REMOTE INDICATOR PANEL KIT
11	57-5500-60	CUSTOM HARNESS & ANNUNCIATOR
12	57-5500-61	REMOTE ANNUNCIATOR "PORT" (Marine)
13	57-5500-62	REMOTE ANNUNCIATOR "STARBOARD" (Marine)
14	57-A550-02	TORQUE SEAL
15	57-A550-03	TEFLON PIPE COMPOUND
16	57-A550-04	POTENTIOMETER ADJ. TOOL
17	57-A550-10	SHIELDED CABLE 2 COND. 15' Length
18	57-A550-11	THERMOSTAT 95 DEGREE C
19	57-A550-12	RPM SENSOR ASSY - 4" Length
20	57-A550-15	RESET KEY SWITCH
21	57-A550-27	INSTALLATION KIT ON-ENGINE
22	57-A550-28	INSTALLATION KIT OFF-ENGINE
23	57-A550-29	FUEL VALVE CONTROL MODULE
24	57-A550-30	REMOTE STATUS ALARM UNIT
25	57-A550-31	20' Light REMOTE UNIT HARNESS
26	57-A550-34	OEM BASIC INSTALLATION KIT
27	57-A550-RT	ALT. "R" TERMINAL CABLE
28	57-A995-01	RPM SENSOR ASSY - 2" Length - 5/8" Th.
29	57-A995-03	RPM SENSOR ASSY - 3" Length - 5/8" Th.
30	57-A995-04	RPM SENSOR ASSY - 3-1/2" Length - 3/4" Th.
31	57-A995-05	RPM SENSOR ASSY - 1" Length - 5/8" Th.
32	57-A995-06	RPM SENSOR ASSY - 4" Length - 5/8" Th.
33	57-A995-07	RPM SENSOR ASSY - 4" Length - 3/4" Th.
34	57-F316-12	FUEL SHUT-OFF SOLENOID 12VDC - 3/16"
35	57-F316-24	FUEL SHUT-OFF SOLENOID 24VDC - 3/16"
36	57-FS14-12	FUEL SHUT-OFF SOLENOID 12VDC - 1/4"
37	57-FS14-24	FUEL SHUT-OFF SOLENOID 24VDC - 1/4"
38	57-SGEN-FT	MINI-GEN - FEED THRU - 7/8" - 18 Th.
39	57-SGEN-MF	MINI-GEN - METRIC - 22 - 1.5 mm
40	57-SGEN-NF	MINI-GEN - NON FEED THRU - 7/8" - 16 Th.
41	57-TEST-EX	HARNESS EXTENDER
42	57-TSDT-06	TEMPERATURE SWITCH - 115C - 1/2" NPT
43	57-TSDT-08	TEMPERATURE SWITCH - 100C - 3/8" NPT
44	57-TSDT-09	TEMPERATURE SWITCH - 105C - 3/8" NPT
45	57-TSDT-10	TEMPERATURE SWITCH - 110C - 3/8" NPT
46	57-TSDT-11	TEMPERATURE SWITCH - 95C - 3/8" NPT
47	57-TSDT-16	TEMPERATURE SWITCH - 150C - 1/2" NPT

REPAIR SERVICE / PARTS/TECHNICAL SUPPORT

The Engine Saver is fully rebuildable. Service, Parts and Technical Support can be obtained throughout the world. Applications assistance is likewise available through the locations listed below and on the following page.

SALES AND SERVICE LOCATIONS

DESIGNED, MANUFACTURED AND SERVICED BY

FLIGHT SYSTEMS, INC.
207 Hempt Road
Mechanicsburg, PA 17050 USA

Tel: 717-590-7330
(US Toll-Free: 800 403 3728)
Fax: 717-590-7327
(US Toll-Free: 800-333-9912)
8-5 ET, M-F
www.flightsystems.com

Sales: Anthony Misiti amisiti@flightsystems.com
Spare Parts: Josh Leeds jleeds@flightsystems.com
Tech. Support: Steve Wida swida@flightsystems.com

Bob York ryork@flightsystems.com

FACTORY REPRESENTATIVES

QUEBEC, MARITIMES CANADA
Daniel DiCesar
3535 Breard Street
Brossard, QC J4Z 2E3 Canada
Tel: 450-656-0344
Email: danieldicesar@videotron.ca

DIRECTOR:AFRICA-ASIA-EUROPE
Klaus-Josef Rossfeldt
Friedensstr. 11
D-58239 Schwerte
Germany
Tel: + 49 (0) 2304 14436
Alt: + 49 174 490 4899
Email: rossfeldt@rrab.de

• *SEE FOLLOWING PAGE FOR US, CANADIAN & INTERNATIONAL INSTALLING DISTRIBUTORS*

INSTALLING DISTRIBUTORS FOR FLIGHT SYSTEMS MARINE & INDUSTRIAL CONTROLS

UNITED STATES

Northeastern USA:
Rhode Island Engine Co. Inc.
79 State St. / PO Box 543
Narragansett, RI 02882-0543
Tel: 401-789-1021
Fax: 401-789-1066
Contact: David Allard
Website: www.RIEngine.com

Southwestern USA:
Cummins Southwest
2339 N. Black Canyon Hwy
P.O. Box 6688
Phoenix, AZ 85009
Tel: 602-252-8021
Fax: 602-253-6725
Contact: Steve Ryberg

West Coast USA:
Cummins Intermountain
5370 East Idaho Street
Elko, NV 89801
Tel: 702-738-6405
Contact: Tom Bland

CANADA

Western Canada:
Cummins British Columbia
18452 96th Avenue
Surrey. British Columbia
V3T 4W2, Canada
Tel: 604-882-5000
Fax: 604-882-5080
Contact: Phil Dunn

Eastern Canada:
Cummins Eastern Canada
7200 Trans Canada Hwy
Pt. Claire, Quebec
H9R 1C2, Canada
Tel: 514-695-8410
Fax: 514-695-9012
Contact: Lucien Fredette

Central Canada:
Cummins Alberta
14755 - 121A Avenue
Edmonton, Alta
T5L 2T2, Canada
Tel: 403-455-2151
Fax: 403-454-9512
Contact: Colin Carmichael

INTERNATIONAL

If no distributor listed for a particular region or country, contact Flight Systems Inc. (On preceding page)

Chile, Argentina, Peru:
Sermagrep S.A.
Marcelo Moukarzel Lira
mm@smgp.tie.cl
Mobile 056-9-9.8176167
Tel 056-2-5561621
Fax 056-2-5556763
Luis Moraga Vigail Service Support
lmoraga@sermagrep.cl
Juana Valenzuela C
servicio@smgp.tie.cl
Tel 056-2-5556763
Fax 056-2-5556763

West/Central Africa, Incl. DR, Congo, Zambia:
Pinnacle Engineering
House Number I/S 47
Site 18, Community One
Tema, Ghana Africa
Tel: 233 223 11225
Contact: Bridge Adams Eshun
pinengineering@gmail.com

South Africa:
CALMAR Trading CC
Unit 4426
Greenways
Strand 7140, South Africa
Tel +27 - (0)21 853 1376
Contact: Marc Haas
mhaas@telkomsa.net

Australia:
Norman G. Clark (A/Asia) Pty. LTD
P.O. Box 281
West Heidelberg,
Victoria 3081 Australia
Tel: (01161) 3 9457 5833
Fax: (01161) 3 9457 5781
Contact: Rob Clark
Website: www.ngclark.com.au

Thailand:
Daven Co. LTD
126/43 Soi Wat Ku Chang Wattana Rd
Pakkred Notaburi 11120
Thailand
Tel: 66 2 964 0878 Fax: 66 2 964 0879
Contact: Pote Pasoog daven@ji-net.com

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• *See Previous Page (35) for a Complete List of Illustrations appearing in this Manual.*